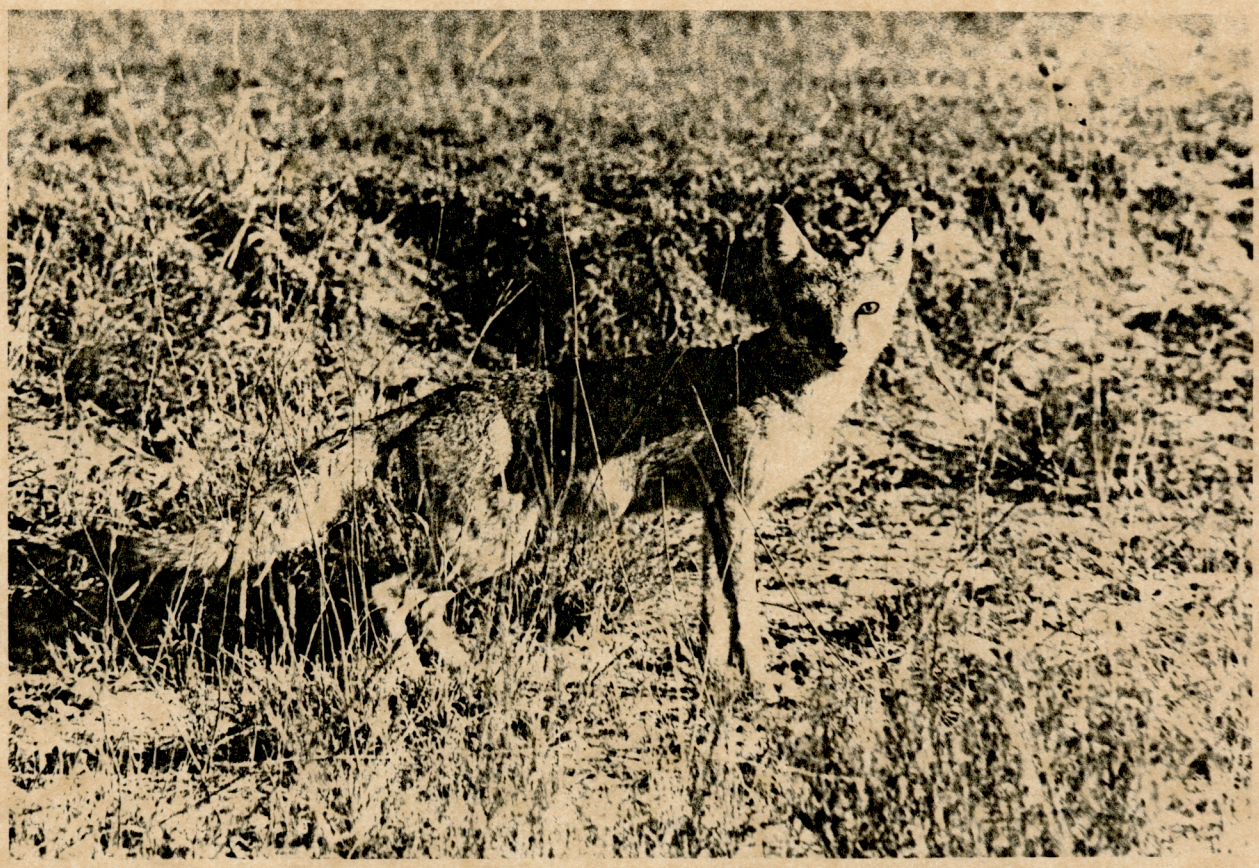
SWIFT FOX CONSERVATION TEAM



1999 ANNUAL REPORT

SWIFT FOX CONSERVATION TEAM

ANNUAL REPORT

COMPILED AND EDITED BY:

C. Gregory Schmitt
New Mexico Department of Game and Fish

September 2000

TABLE OF CONTENTS

Minutes of the 1999 annual swift fox conservation team meeting, Phoenix, Arizona 1

1999 swift fox conservation team members 23

1999 swift fox conservation team participating cooperators 26

Summary of swift fox research near Medicine Bow, Wyoming - summer 1999 28

Swift fox completion report (Wyoming) 33

Swift fox investigations in New Mexico, 1999 38

Texas annual summary of swift fox conservation and management activities 46

Swift fox investigations in Oklahoma, 1999 48

Swift fox conservation team action items for 1999 (Kansas) 57

Survey of furbearers in Fall River County South Dakota with emphasis on swift fox (*Vulpes velox*) 59

Investigation of furbearer occurrence in North Dakota with special reference to swift fox, 1999 66

Swift fox investigations on National Grasslands, 1999 73

1999 swift fox survey, Fall River ranger district Buffalo gap National Grassland, Nebraska National forest 75

Preliminary report to the swift fox conservation team: historic and recent distribution of swift foxes in North America 80

Swift fox reintroduction guidelines..... 119

Summary of the 1999 swift fox track survey in Nebraska 189

Montana swift fox management activities 191

Overview

Schmitt, C. Gregory, ed. 2000. 1999 Swift fox conservation team annual report

Personnel from state and selected federal wildlife agencies have met annually since 1994 as representatives of the Swift Fox Conservation Team (SFCT) to report on research and management activities on the swift fox within the 10 states that comprise the historic range. Research and management activities conducted within the range of this species have generally followed goals and objectives presented in the Conservation Assessment and Conservation Strategy for the Swift Fox in the United States. Information acquired by state wildlife agencies have been compiled annually; this document represents the fifth annual report summarizing activities of the SFCT.

During 1999, the status of the swift fox as a Federal candidate species has remained unchanged. Based on information collected by the SFCT and others, the SFCT continues to support its previous position that the swift fox be removed from the candidate species list.

Progress continued on a peer reviewed publication of the proceedings of the first International Swift fox Symposium held in Saskatchewan in February 1998. Topics included conservation (5 papers), status (4 papers), taxonomy, physiology, and disease (5 papers), census techniques (4 papers), population ecology (6 papers), behavior (3 papers), and miscellaneous topics (2 papers). A summary of the completion status of conservation strategy objectives scheduled for completion and initiation by 1999 follows.

3.1.1 The SFCT will assign members to a technical committee for the purpose of reviewing techniques, scientific literature and findings from current swift fox research studies to develop recommendations for standardized population monitoring techniques. This committee was formed and a review of population monitoring techniques was conducted. There are several techniques being used to monitor swift foxes throughout their range. Because of the variety of biological and economic conditions state wildlife agencies face, there is presently no consensus concerning what methodology should be adopted throughout the range of the species. Methodologies used by researchers have been presented in past SFCT annual reports.

3.1.2. Each state wildlife agency will coordinate and implement a monitoring program for existing swift fox populations or newly established populations in cooperation and with assistance of federal agencies (BLM, USFS, USGS, APHIS) and other interested parties such as tribal governments, state universities, research institutions, and private landowners. Statewide monitoring programs will be implemented by 1999, dependent on the development of standardized techniques. As mentioned above, there is no consensus concerning monitoring techniques. For example, during 1999, tracking plates were used in Wyoming; track surveys in South Dakota, Montana, Kansas, and Oklahoma; spotlight surveys on the Pawnee National Grasslands in Colorado, and scent stations in New Mexico. Even though different methods for monitoring swift fox populations have been employed by state wildlife agencies, swift fox monitoring has occurred in every state within the historical range over the past five years.

3.1.3 The state wildlife agencies of Kansas, New Mexico, and Texas which allow a legal harvest and Wyoming for incidental take of swift fox, will evaluate the feasibility of implementing a registration/pelt tagging program in addition to conducting mandatory carcass collections. Pelt tagging for foxes has been in place since 1994 in Kansas. There is presently no pelt tagging requirement for fox specimens taken by trappers in New Mexico; however, the take of this species is thought to be insignificant.

5.1.1 The SFCT will review scientific literature and incorporate findings from current swift fox research projects, particularly the Canadian swift fox reintroduction program, to develop range wide habitat criteria. Annual reports for the previous four years have contained information on this on-going objective.

5.2.1 Each state wildlife agency will coordinate with state and federal land management agencies and private landowners to conduct habitat inventories. Annual reports for the previous four years have contained information on this on-going objective.

5.2.2 Each state wildlife agency will delineate available swift fox habitat on state cover maps utilizing the geographic information system (GIS) and gap analysis, report habitat acreage sizes, and describe landownership patterns in an annual report. Annual reports for the previous four years have contained information on this on-going objective.

8.1.1 The SFCT and state working groups will coordinate information exchanges with similar species working groups, cooperating agencies, universities and conservation organizations beginning in 1999. All previous annual reports, publication of the proceedings of the first International Swift fox Symposium held in Saskatchewan in February 1998, and normal exchange of information contained in research reports have been and will continue to serve as a means to disseminate these kinds of information.

MINUTES OF THE SWIFT FOX CONSERVATION TEAM
1999 ANNUAL MEETING

NOVEMBER 29, 1999
EMBASSY SUITES HOTEL
PHOENIX, ARIZONA

The meeting was called to order at 12:10 pm.

In attendance were (names in bold indicate Team representatives or their surrogates): **Julianne Hoagland**, Oklahoma Department of Wildlife Conservation; **Eileen Dowd Stukel**, South Dakota Game, Fish and Parks; **Robert Sullivan**, Texas Parks and Wildlife Department; **Greg Schmitt**, New Mexico Department of Game and Fish; **Brian Giddings**, Montana Fish, Wildlife and Parks; **Bob Luce**, Wyoming Game and Fish Department; **Christiane Roy**, Kansas Wildlife and Parks; **Mike Fritz**, Nebraska Game and Parks Commission; **Mark Hilliard**, BLM; **Marsha Sovada**, US Geological Service (USGS) Northern Prairie Wildlife Research Center; **Pete Gober**, USFWS (for Dave Allardyce); **Jeff Green**, APHIS-Wildlife Services (for Rick Wadleigh); Paul Robertson, Texas Parks and Wildlife Department; Axel Moehrenschlager, Calgary Zoo; Robert Harrison, University of New Mexico; Lu Carbyn, Canadian Wildlife Service; Kevin Honness, Turner Endangered Species Fund; Kristy Bly, Turner Endangered Species Fund; Kyran Kunkel, Turner Endangered Species Fund; Minette Johnson, Defenders of Wildlife; Jonathan Proctor, Predator Conservation Alliance; Tarren Wagener, Fort Worth Zoo; Michael Fouraker, Fort Worth Zoo; Susan Linner, USFWS.

Team members not present: **Steve Allen**, North Dakota Game and Fish Department; **Rick Kahn**, Colorado Division of Wildlife; **Bob Hodorff**, US Forest Service (USFS) National Grasslands; **Steve Brechtel**, Alberta Fish and Wildlife Division.

Status of Revised 12-month Finding for Swift Fox - USFWS

Pete Gober provided an update on the status of the revised 12-month finding on the status of the swift fox. Pete stated that his office has been busy with other things, especially the black-tailed prairie dog issue. The USFWS listing priority guidance places responses to petitions over candidate species review. This along with limited staff and resources, the Pierre field office has had to focus on more pressing issues, primarily responding to the black-tailed prairie dog listing petition. Dave is retiring at the end of the December, 1999, and Pete doesn't know yet who will be handling the swift fox issue from his office. Marsha Sovada provided assistance, under contract between USFWS and USGS, with the review of the scientific literature for the revised 12-month finding. As a result, Pete felt the document was much stronger than the original Candidate and Listing Priority Assignment Form. Pete agreed that the USFWS has a better understanding of what is going on out there on swift fox.

Before the revised 12-month finding can be approved, it needs field office concurrence from 10 states, regional office concurrence from 2 regions, and concurrence from the Washington office. The decision to either remove the swift fox from the candidate list or not will

The December 9, 1999 written response to the Team's March 31, 1999 letter urging the USFWS to continue moving forward with the swift fox candidate removal process, is attached.

Question: Eileen: Time frame?
Answer: Pete: A recommendation from our Field Office will be forwarded to the Region in early 2000. A package needs to be put together for entering into federal register and that won't happen until after the holidays. Candidate species review is not a priority for the USFWS. Field Office products and expenditures need to be directly tied to the listing priority guidance.
Question: Robert Sullivan: Is the recommendation of the 12-month finding to take the species off the list entirely?
Answer: Pete: That's the recommendation that was leaked out inappropriately when Dave Allardyce shared the Candidate and Listing Priority Assignment Form with the Team in 1998. Pierre office must defer to Washington to make that call.
Question: Christiane: Can we publicize that removal of the swift fox from the candidate list is underway?
Answer: Pete: We can't say for sure what the Director will say. It is her call.
Question: Marsha: The recommendation could potentially change once it goes through all the channels.
Answer: Pete: That's highly unlikely. But, we can't make that call on what the final revised 12-month finding will say. Can't stress enough that this is up to the USFWS Director in Washington.
Question: Christiane: When does the revised 12-month finding become a public document?
Answer: Pete: Anything can be "FOIAed" (Freedom of Information Act); but the finding will become public when published in the federal register since there is no intermediate step for public comment.

Proposed Swift Fox Conservation Team Position/Guidance for Reintroductions - Eileen Dowd Stukel

Eileen introduced the topic. In the Swift Fox Conservation Assessment and Conservation Strategy, the Team rated reintroduction as a low priority from a range wide perspective, because swift fox are doing well in much of their range, and it was more important to concentrate on maintaining swift fox where they occur rather than spending lots of money and time on reintroduction. However, we learned at last years Annual Coordination Meeting that there is interest in reintroducing swift fox into areas where they historically were found but are no longer present. It was decided at that time, that the Team would try to develop Team sanctioned guidelines for reintroduction programs. These would be only guidelines not regulations, unless an agency tied them to their regulations. A Subcommittee was formed to work on this issue and consisted of: Eileen, Axel, Lu, Tarren, Dave Allardyce, and Mike Fouraker. Lu and Axel recommended starting with The World Conservation Union (IUCN) guidelines. Another aspect of the committees' work has been trying to get a handle on the state laws and regulations that might be involved in swift fox reintroduction. Eileen sent regulation surveys out to all Team

members, but has had little response. Team members need to return these surveys to Eileen ASAP.

Team members have also all received draft reintroduction guidelines ahead of time which we will be reviewing today. The draft guidelines were only distributed to Team and Committee members in order to control the number of revisions that may end up being distributed. A final document will be submitted to the 1999 annual report and will be available upon request.

Canadian Reintroduction Efforts

Lu - There were no new releases last year in Canada. No further releases are planned in the future. That is not to say that they won't decide later on to continue with releases in Canada, but for now the releasing is completed. Over the 14-year period Canada has released over 900 foxes and established a population of about 300 animals. The important thing is that population has become established and is reproducing. Axel and wife Cynthia did a survey last winter. Another survey is planned to evaluate the population. Swift fox were extirpated from Canada by the 1930s. The population now seems to be doing quite well in the area where it had been extirpated. Maximum number of foxes released at one time never exceeded about 60. Although officially Canada is done with swift fox reintroduction, the recovery team is still in place and meets once a year. And the mechanism is still in place to continue swift fox reintroduction in the future, should it be deemed necessary. The Committee on the Status of Endangered Wildlife in Canada completed an updated status report on swift fox which down listed the species from extirpated to endangered. This is good news.

Axel - A population assessment was done in February, 1999, and essentially repeated what they did in 1996-97 in a subsampled area to determine whether any intensive management was needed to prevent a population crash. The assessment involved primarily trapping survey, but also incorporated spotlighting and timed track searches. The results from trapping randomized townships from the previous census were encouraging. Slightly more foxes were caught in the same areas with a seemingly lower trapability of foxes, and also, in terms of total distribution of the main subpopulation in Canada (remember there are two subpopulations). This gives an indication of population stability. There is going to be another census of the Canadian and Montana population, looking eventually at the population's viability. The question remains whether the population can sustain itself. Appendix B.

Last year, 1080 poison was authorized for use in Saskatchewan. A no-poison zone was established which encompasses the area where swift fox occurred. Beyond that zone, however, 1080 poison can be used. Conservation Officers administer the poison on behalf of ranchers. A workshop was conducted to determine how to evaluate for swift fox prior to bait placement. The government of Saskatchewan determined to use scent stations over three consecutive nights. If no swift fox sign is observed, the conservation officer can set out the poison. Chicks laced with poison are placed in holes to reduce avian predation. In the workshop, they covered how likely it is to find sign with this type of survey in order to make sure that swift fox aren't in the area. Based on known information, it was determined that with this method, the likelihood of finding a

swift fox whose home range overlapped the transect was about 30%. In Alberta, the issue is coyote snaring. Stopping snares still have the potential to capture swift fox around the middle.

Comment: Marsha: If you set snares correctly and monitor them there should be no reason to catch swift fox.

Response: Axel: The issue in Alberta is kill snares and swift fox being captured. Canada is getting its first Endangered Species Act. How these issues will play into this process is unclear. We are hoping the act will be pro landowner.

Comment: Lu: One should look at the implications of poisoning to the ecosystem. In terms of swift fox, poisoning might actually benefit them; although ethics is questionable.

Comment: Brian: This would work for snares too.

Comment: Lu: Right.

Response: Axel: In his study, there was an intensive coyote kill which resulted in a significant reduction in coyotes. Incidentally, however, they had the highest mortality rate among swift fox during that time, because of increased avian predation on swift fox. One could argue that getting rid of coyotes in Canada might make it easier for eagles to prey upon swift fox because coyote absence makes prey available for migrating eagles which consequently are more likely to settle in the swift fox area. Coyote control does not necessarily benefit swift foxes.

Comment: Lu: The emphasis of the Canadian ESA will be on incentives, but there will be some punitive aspects as well. More likely to be called a Species at Risk Act (SARA).

Turner Properties Swift Fox Reintroduction Program - Kyran Kunkel

Kyran thanked the Team for the meeting invitation and the opportunity to interact with the Team. The Feasibility Study Plan for the Reintroduction of Swift Foxes to Turner Properties in the Great Plains was sent out to Team members and others for review, and the group appreciated the comments they received on the document. Ted Turner is the largest private landowner in the US. And he is interested in doing conservation work in the area where he has properties. The Turner Endangered Species Fund (TESF) is a division of Turner Enterprises, concentrating on the conservation of imperiled species on Turner properties. These properties currently encompass about 2 million acres in the U.S., and continue to increase. The focus for conservation efforts is on private lands. Currently, Turner is concentrating on the grasslands. In South Dakota, Turner owns the Bad River Ranch, on which swift fox restoration is one of the primary projects proposed. TESF doesn't want to go it alone; they want input from the Team and as much expertise as they can round up. For example does it make sense to go ahead with a reintroduction and in the manner in which they are proposing? Currently working to address the comments sent by the Team on the Feasibility Study. The next document TESF will produce will be an actual reintroduction plan. TESF is using the IUCN reintroduction criteria. Reintroducing swift fox on the Bad River Ranch in South Dakota will be an experiment. Lu

Carbyn has been very much involved with this project, and is the initial author of the Feasibility Study.

Question:	Christiane: Is there a time line?
Answer:	Kyran: No. If the feasibility work looks good, the earliest reintroduction would take place next fall.
Comment:	Lu: This is an impressive initiative. It is an opportunity for the Team to take conservation efforts forward into another arena. Turner has the resources for putting in place surveys for prey, etc. This is an exciting effort to look at the bigger picture. In that regard there is opportunity for north-south involvement in looking at where the swift foxes are, and looking at the various components that appear to be important there, and then looking at areas where we think the swift foxes ought to be and aren't and determining why the foxes aren't there. If we had the kind of surveys being done on the Turner ranch in South Dakota going on throughout the range, both where swift fox occur and where they do not, and then compare these data, we could help answer this question.
Comment:	Kyran: TESF is also interested in black-tailed prairie dog reintroduction and ultimately, black-footed ferret reintroduction.
Comment:	Christiane: The states have been working hard for many years to find out where swift fox occur. We are now working on looking at variables like habitat to answer where they are not. States still feel that there are other higher priorities at this time. This is a good study, but there are other higher priorities.
Comment:	Pete: Priorities vary between agencies and publics.
Comment:	Brian: That is why we have Conservation Assessment and Conservation Strategy (CACS). The Canadian reintroduction program was undertaken because it was the only option for the species there.
Comment:	Eileen: The CACS is a range wide plan; states may have different priorities. In South Dakota, the swift fox is a state threatened species, and SD is legally mandated to recover it. But, agree that the CACS shows the direction of the Team.
Comment:	Brian: Need to assess how the proposed Turner ESF reintroduction fits into the CACS.
Question:	Bob Sullivan: There are a large number of interests here at stake concerning the swift fox, yet it' s not really a priority for the USFWS. That priority is determined by the status of other species. Whereas the states may be more limited in the species they have to address and therefore the swift fox is a higher priority for the states.
Answer:	Pete: If the swift fox is removed from the candidate list, South Dakota could move along more easily at restoring the species to the state because the threat of listing would be removed from private landowners.
Answer:	Susan: The USFWS has a limited amount of money and must set their priorities.
Comment:	Marsha: Addressing the Turner ESF Feasibility Study proposal. Although food availability is important, historically food has not been a big issue for swift fox.

Invertebrates are difficult to measure, and everything is so dynamic in the prairie that what you get this year may not be what is there next year. It would be nice to see the reintroduction proposal long before implementation. We received this proposal after some parts of the plan were already underway. The Team has a lot of expertise and knowledge and Turner ESF should use it. We are all working toward the conservation of swift fox.

Response: Kyran: Hope to have the next phase proposal done by the end of the year. We're not locked into reintroduction, and if it makes more sense to put our money into another facet of conservation, we would be open to do that. It doesn't have to occur on Turner properties. We are interested in carnivore conservation and restoration.

Question: Christiane: Has South Dakota considered using natural expansion or translocation of their current population from Fall River County versus reintroduction? If South Dakota has a population that is unable to increase or disperse, why spend a lot of money to bring foxes in from somewhere else without spending the same amount of money determining why they aren't there in the first place. Or spend the money trying to make the existing population more successful. And, if you can't make it more successful, how can a reintroduced population be more successful?

Response: Paul: The reintroduced population could be more successful.

Response: Kyran: We are still looking at these questions. Has the range been expanding or shrinking? Or is the range expanding only because you are looking?

Comment: Eileen: South Dakota would not support a translocation at this time. The USFS is only looking on federal land and not on private land.

Comment: Paul: The science of reintroduction is an art. You could spend a lot of time doing science to get an answer that is not meaningful. Sometimes you just have to do it and let the chips fall where they may. That is really where we are in our understanding of the science of reintroduction.

Comment: Lu: We need to bring as much science into the art as we can.

Comment: Marsha: Regardless, I'm sure Turner wants to spend his money wisely.

Blackfeet/Defenders of Wildlife Reintroduction Program - Minnette Johnson

The Canadians have been successfully reintroducing swift fox for 16 years and are winding their program down. They had planned to release the remaining captive foxes in Grasslands National Park. In the meantime, there was an absence of swift fox in the state of Montana. So the Blackfeet Tribe, Defenders of wildlife and the Cochrane Ecological Institute entered into a partnership to initiate a reintroduction program in Montana. The swift fox was once common in Montana. There were 43 sightings near Browning, MT, near the release site, but no sighting records have occurred in recent times. Since 1978, swift fox occurrence records were associated with the Canadian reintroduction program. In 1993 a habitat survey was conducted by Brian Giddings, Craig Knowles and Mamo. They identified the best remaining tracts of grassland on the Blackfeet Reservation. Craig Knowles did a site assessment in 1998 to

look at the prey base and habitat availability. He found tons of Richardson's ground squirrels and other small mammals and burrows for swift fox. So, they decided to proceed with the swift fox reintroduction. Thirty juvenile swift foxes from the Cochrane Ecological Institute were brought to the Blackfeet Land via Browning, Montana. Eight protective shelters were placed on top of swift fox burrows, and the foxes were fed and watered for the night.

The first release was last year (1998). None of the foxes were radio collared, partly because of expense and partly because of the Blackfeet's wishes to keep a low profile to keep outside interference to a minimum. Last summer (1999) another 15 swift fox - 3 juveniles and 12 adults - were released. Juveniles had poor survivorship. Montana Department of Fish, Wildlife and Parks provided eight radio collars for adults. The swift fox were monitored for one month after release. Of the 45 releases - two died from road kills and two died from ranch dog conflicts. The 1998 released foxes produced four successful litters. Sixteen swift fox were seen by spotlighting in one night in the area of the release site during the 30-day period following the release. They lost two of the collared animals. Blackfeet Fish and Wildlife Department will be monitoring radio-transmitted foxes with fixed-wing aircraft. Defenders are committed to reintroducing a stable population in the area and will be reintroducing more captive foxes next year. But Defenders is also interested in reintroducing wild foxes, and are looking for a wild fox source. They are also trying to get more radio collars.

Comment: Brian: Montana will put the radio-collar information in the annual report; dispersal, natal den location, direction and distance, survival as well. Den sites are really important. The Blackfeet land is a good site. The breeding stock at CEI came originally from South Dakota and Wyoming.

Question: Eileen: Defenders is committed to a self- sustaining population - do you know what will that be?

Answer: Minnette: Defenders is committed to 3 years of reintroduction and then will assess. A three-year budget is all they can afford at this time.

Comment: Lu: It is good to see Defender's proposal and discussion. Projects should never be carried out in isolation. Can create problems.

BREAK

Eileen went through the guidance that was pre-mailed. The guidance was developed from a telephone brainstorming session between Eileen and Axel, and then incorporating Lu's specific suggestions. Then these ideas/comments were circulated among the subcommittee, and finally organized in a planning mode.

The Team and participants proceeded to go through the guidance document section by section. Eileen took suggested comments for changes and incorporated them into a second draft which was sent out on 12/3/99. Comments on second draft were due December 20. Literature will be added after review of the second draft.

Question: Minnette: Will the Team continue to go on record as not supporting the Blackfeet reintroduction? It states in the Team's 1998 report, the Team was not involved with this reintroduction [on the Blackfeet Indian Reservation] and does not support reintroduction of swift fox at this time.

Response: Julianne and Christiane clarified that the statement from the 1998 annual report was not directed at any particular reintroduction program, but rather was only reiterating what is already in the Conservation Assessment and Conservation Strategy - The Team does not support reintroduction of swift fox as a high priority for conservation of the species at this time. Reintroduction is a low rangewide priority.

Comment: Minnette: The Team's low conservation priority of reintroduction programs is perceived by the Blackfeet and the public in general as the Team not supporting individual reintroduction projects being conducted by other entities. As a result, people could question the Blackfeet's program because the Swift Fox Conservation Team feels that reintroduction of swift fox into suitable unoccupied habitat is a low conservation priority at this time.

Response: Christiane: The Team is addressing reintroduction at this time, however, because of the interest by others to undertake these projects, understanding that in certain situations, these programs have merit. But, that doesn't change the overall opinion of the wildlife biologists who form the Team; that this activity is a low priority for rangewide conservation of the species.

Comment: Marsha: There are mostly state agencies involved here and they have a lot of responsibility and very little resources for species conservation. Therefore, it is necessary for the conservation activities be prioritized so that conservation can move forward, understanding the limited resources available. The Team did not direct its reintroduction comments at last year's meeting toward any group or individual.

BREAK

International Swift Fox Survey

The agenda was re-arranged and Axel proceeded to present the international swift fox survey. Canada is now looking at whether the swift fox population is viable. As with all reintroductions, you get to the point where you have to ask how much is enough. And Canada is at that point. There have been 26 years of reintroduction effort. A lot of credit is due to the Cochrane Ecological Institute and the Canadian Government. Over 1000 foxes were released. The 1996-97 survey determined where the Canada foxes are. The goal now is to determine the total distribution of the contiguous Canadian and Montana swift fox range. Canada has a population estimate, but a total population estimate is needed. And finally, we need to get at the question of population viability. The results of the 96-97 survey on the Canadian side will be used as a basis for the total census coming up in 2000 and 2001.

The 1996-97 was a trapping survey. During the 1996-97 survey, the winter was horrific. Blizzards and snow made it difficult to trap during that survey. Traps were checked twice per night, and standard measurements were taken on foxes captured and vaccinations were given. The upside of the bad winter was that the foxes were weather stressed as well (i.e. food stressed) which made them easier to capture and recapture. The foxes extend their home ranges significantly during the winter because of this food stress.

The potential distribution of swift fox was estimated by trying to classify the potential townships where there might be foxes based on habitat parameters. In Canada, there was an area of about 10,000 km2 in two different sub-populations in Montana, Alberta, and Saskatchewan. The project intended all along to have two separate sub-populations in case of disease outbreak or some other stochastic factor in one of those areas.

Of the 108 townships that comprised the potential distribution, 75% were selected randomly to be surveyed. Within the selected townships, six traps were placed centrally, one km apart. Neighboring transects were greater than six km apart. Townships were trapped for three nights. Because foxes with radio collars were being followed at the same time, random placements of traps within home ranges was done to see how catchable individuals were that we knew were present. Four out of 13 foxes were captured for which good home range information was available. A calibration index was established that defined what it meant when a certain number of foxes was captured in a given area.

In the western and larger sub-population a purely random design was used. Captures were centralized and 24 individuals were caught. A density estimate was calculated of 3.2 fox per 100 km2, which is very low compared to other areas. The sub-population estimate was 192 foxes. One new capture was made every 24 trap-nights. Replicating just the central portion increased the catch-rate to one individual every 20 trap-nights. In the eastern subpopulation, eight individuals were captured mainly in the eastern region, further illustrating that the two sub-populations are split on the Canadian side and there may be no gene flow. The density was lower and the sub-population estimate was about 87 foxes which is quite small.

It is important to recognize that there are two sub-populations and that a fragmented population of roughly 300 individuals isn't the same as one population of 300 individuals. Many of the captures were along the Montana border and we know that there are foxes in Montana. So the question is not what we want for a Canadian population, but for a biological population and for viability as well.

Question: With only eight animals caught, what is the Confidence Interval on the population estimate?

Answer: Axel: The boot strap is quite large. The accuracy of the population level is still being modeled.

In terms of the 2000-01 census, we will be looking at habitat analysis. A geographic information system (GIS) map which has land use, topography, water and road layers has been

created. At a national level, both sites where there were captures and where there weren't and what the habitat parameters were, respectively will be compared. To determine habitat use parameters on an individual fox level, individual relocations versus random points within home ranges will be examined. This habitat model will be used to make a priori cutoffs to determine which townships should be used in the next census. Determining these habitat requirements will be useful in managing swift fox in cold varying conditions.

In terms of trapping, the 1996-87 census will be replicated. Additional trapping will be done in randomly selected Canadian townships, as well in Montana townships. We will also be looking at disease and parasites since this has not been done before to at least comment on what diseases are there and what their effect on the swift fox may be. This information will increase the quality of the data going into the model for population viability analysis (PVA). Habitat analysis will begin early in 2000 with preparation and staff training from February to October 2000. Trapping will be from October 2000 through February 2001. This time frame replicates what was done in 1996-97. Analysis and ultimately the PVA and submission of research for publication will be in 2001.

The swift fox program in Canada has been the result of many individuals, and it is a success. It is the most successful reintroduction of a carnivore from a country where it was extirpated. This evaluation will give us an indicator of whether the population is viable. Results will be presented back to the Team in a year or two.

BREAK and move to Gazebo.

Committee Reports

Julianne requested that each committee chair provide a short written report of what they will be presenting to be included in the meeting minutes.

Education Committee - Christiane and Tarren

Christiane reported that the shortgrass video Kansas prepared and has been distributed. The newsletter idea was re-visited to determine strategies and interest. One idea discussed last year was to provide articles to Tarren and other publications that are already in existence out there. The earlier newsletter prepared by the Education committee was never really distributed.

Comment: Julianne: Last year we decided to wait to produce another newsletter until the Candidate Assessment form was completed and the decision to either remove the swift fox from the candidate list or not was made by the USFWS. At the time of last year's meeting in Amarillo, we were anticipating that decision within a six month time frame. But since it has been a year and we still don't have a final revised 12-month finding published on the swift fox, the question was raised whether we should go ahead and produce another newsletter now and not wait for the decision. We also discussed at last year's meeting, to use existing land-based newsletters to distribute articles to these groups rather than producing our own

newsletter. Lesser Prairie Chicken group distributed 40,000 surveys through the Farm Services Agency and had less than 1% return and made the printing and postage costs not attractive. Which is why we looked toward this other avenue.

Comment: Christiane: We could rotate the effort to write the article for distribution in these other publications.

Comment: Eileen: The Team has been meeting since 1994 and we have produced one newsletter. It may not be the best tool, but it is one tool to get our information out to the public. What is our message? We have a successful international cooperative program and this is unusual. We need to get the story out.

Suggestions were made to put the newsletter on the state agency web-sites and to get it into ranching and landowner magazines.

Comment: Paul: Need a variety of avenues to take the articles to the right place - need a person in each state to walk the article produced by the Team to the appropriate places and to modify it as needed for that particular audience.

Comment: Mark: Target articles for specific geographic rural areas. Mark is willing to work on this.

Comment: Mike Fouraker: Early morning TV and radio programs are good for reaching rural landowners.

Final agreement was for each member of Team to write a paragraph on their recent activities and submit to Eileen. Eileen and Christiane will put together a newsletter. Each Team representative will then be responsible for distribution in their state/region, using the suggestions and examples listed above.

Swift Fox Captive Conservation Program - Tarren Wagener

Focus

The Swift Fox Conservation Team and American Zoo and Aquarium Association (AZA) Canid Taxon Advisory Group (TAG) have endorsed the Fort Worth Zoo to spearhead the development of a cooperative captive conservation program for the swift fox. The objectives of this program are threefold: 1) to assist in the development of a nationwide conservation awareness and education program; 2) support Swift Fox Conservation Team field efforts; and 3) maintain a healthy, genetically-viable captive population.

Activities

Conservation Education

Development of a two-sided full-color brochure and poster highlighting the swift fox, its conservation status, ecological role and the prairie habitat. The poster will also provide

post-sighting contact information and add to the database of the current status and distribution of the fox.

Integration of swift fox information into Canid TAG and North American Conservation Action Partnership web sites.

Development of swift fox art and T-shirts for educational and fund-raising efforts

Field Conservation

Purchase and loan of hand held Global Positioning System (GPS) unit to Texas Team member to assist in the location and marking of den sites.

Development of restricted list serve for the Conservation Team

Collection of developmental data to assist field biologists with aging kits

Submission of several conservation research grants on behalf of the Team

Establishment of swift fox conservation program account

Research/Development of Technology

Investigation of multi-institutional swift fox reproductive biology study with biologist Dr. Cheri Asa (St. Louis Zoo).

Investigation of effective contraceptive implants

Purchase and loan of den probe to Texas Team member.

Captive Programs and Exhibition

Named as a priority small-canid species on the Canid TAG Regional Collection Plan

Petition for AZA Swift Fox Regional Studbook and Species Survival Plan in progress.

Eleven zoos in the U.S. and Canada have received swift foxes and/or participate in this program (Fort Worth Zoo, TX; Houston Zoo, TX; Bramble Park Zoo, SD; The Living Desert, CA; Great Plains Zoo and Museum, SD; Sunset Zoo, KS; Wild Canid Survival and Research Center, MO; Lee Richardson Zoo, KS; Dakota Zoo, ND; Kamloops Wildlife Park, BC, Canada; Valley Zoo, Alberta, Canada). The current population is 28 foxes (11.17). An additional six zoos are interested in receiving foxes and participating in the coordinated program.

Swift Fox Captive Conservation Program Meeting held at AZA National Conference (September 1999). Two organizations pledged $1500 towards educational poster production at the meeting.

Comment: Axel: Calgary Zoo has an endowment fund that gave over $100,000 to different projects for conservation work in the wild. There is potential for support for Team from this fund. Their primary interest is in the conservation of Endangered Species in the wild.

Comment: Lu: Would like to see a chapter from the zoo community in the swift fox book (Tarren and others).

Habitat Committee - Julianne, Bob Luce, Axel

USGS Landuse Data Layers

All USGS landuse and cover ArcInfo coverages for the swift fox historic range have been downloaded from the EPA ftp site and converted into ArcView shapefiles. Broad maps can be generated to look at different landuse categories. For example, herbaceous range, shrub range, mixed range, and cropland can be mapped for the Southern High Plains. The USGS landuse data layers were generated in 1990 from several sources of information, including high altitude aerial photography, hydrologic unit maps, federal landownership maps and state landownership maps. Keep in mind, the cropland category also includes tame pasture and CRP.

USGS landuse categories in Beaver, Harper, Ellis and Woodward counties (Oklahoma) were ground verified in the townships surveyed for the swift fox track search survey.

The USGS site that has their GIS data online is http://edcwww.cr.usgs.gov/doc/edchome/ndcdb/ndcdb.html and the EPA site where the Landuse cover data has been converted into ArcInfo coverages is ftp://www.epa.gov/pub/EPAGIRAS/mgiras/. You need to know the quadrangle name and longitude and latitude of the SE corner of the quad in order to download the appropriate file.

Oklahoma's digital orthophoto mapping program

The State GIS Council, in cooperation with the NRCS, the Farm Services Agency, and the USGS developed digital orthophotos for the State of Oklahoma. A digital orthophotograph is a digital image of an aerial photograph in which displacements caused by the camera and the terrain have been removed. It combines the image characteristics of a photograph with the geometric qualities of a map. A digital orthophoto serves as an excellent base layer which can be used for viewing specific data in a GIS. It can be a valuable tool for revising digital vector files and topographic and planimetric maps.

All aerial photographs for the state of Oklahoma were taken in 1995 & 1996. The state will be re-flown every five years. The USGS developed the digital elevation information by using data from 7.5 minute quadrangles and sophisticated ground truthing techniques, resulting in a digital three-dimensional image of the earth. Finally, the aerial photograph was combined with the digital information to produce an accurate photograph that was scanned into digital format. The result is a black-and-white, 1-meter ground resolution image, at a scale of 1:12,000, meeting National Map Accuracy Standards.

Digital orthophotos for Oklahoma can be stored on CDS or electronically transferred, and are available free of charge via a ftp web site on OneNet, the official telecommunications network for Oklahoma education and government.

Other Potential Data Sources

Mapping of lesser prairie chicken leks and habitat within 3 km of known leks has been done in the Oklahoma & Texas panhandles by Oklahoma State University, using aerial photography and development of ArcInfo coverages.

Question: What about using Geographical Approach to Planning for Biological Diversity

(GAP)?

Response: If GAP is done for a state, use it. But GAP has not been completed in all states.

Comment: Pete: used USGS land use category data for the prairie dog and found them to very accurate.

Wyoming

Bob Luce demonstrated a run using GAP information, which is satellite imagery, picking shortgrass prairie. There are multiple layers that you can use in GAP. It can be refined even further to look at density differences. A couple of pilot projects are underway. One is to take satellite data with TNC and look at a particular pixel and determine not only the vegetation there but acres on the ground covered as compared to the standard; or how much vegetation has been taken; or the relative value of the ground cover. Wyoming TNC and Wyoming Game and Fish will be attempting to develop a method to not only plot the habitat in the range of the black-tailed prairie dog, but also to assign habitat values down to a very small area (about 15m). In that way, they can map prairie dog colonies and attempt to record changes (i.e. changes in vegetation) over time. This method is being used for black-tailed prairie dogs to help determine the potential and actual range. This gets at the potential range. In terms of the actual range, Wyoming Game and Fish is working with the University of Wyoming. Digital orthophotographs taken in Wyoming in 1994 with a 1 meter resolution at 1:24,000 work well for mapping black-tailed prairie dogs. The University of Wyoming will use landsat multi-spectral imagery to map habitat by vegetation and other criteria for a particular species. The University of Wyoming Department of Renewable Resources has put together a proposal and secured funding ($57,000) for a pilot project to map black-tailed prairie dog towns and test a method of monitoring the size of colonies over time. The project will use Landsat TM multi-spectral imagery (20 - 30 m resolution). This is only in the beginning stages right now, but will move forward within the year.

This started as a project for the black-tailed prairie dog, but will be used to look at grasslands/rangeland as a whole. Since the black-tailed prairie dog and swift fox have similar historic ranges, it's possible this methodology could be a breakthrough for plotting actual versus potential swift fox range as well as being able to assign a quality index to the habitat.

Canada

In collaboration with Grasslands National Park and the Canadian Plains Research Center, a GIS map with land-use, topography, road, and water layers will be created for the Canadian swift fox range. Utilizing trapping data from randomized locations in 1996/1997and 1999, a habitat model will be constructed to determine which components are most crucial to swift fox presence on a national level. Moreover, the habitat composition of swift fox home ranges that were monitored from 1995-1998 will be assessed. Within home ranges, differences in the distances of relocations and random points from water bodies, roads, fence-lines, and rugged terrain will be tested to determine swift fox habitat requirements on a small scale. Habitat utilization results will provide valuable insights into swift fox ecology in seasonally cold climates in general and the northern periphery of the range in particular. Moreover, model results will be applied to set boundaries of potential trapping areas for the 2000/2001 population census in Alberta, Saskatchewan, and Montana. Following the census, habitat analyses will be repeated

incorporating Montana portions of the range and to test for changes in habitat use between years.

Question:	Christiane: Is there an effort of the habitat committee to work with the black-tailed prairie dog and other species groups?
Answer:	Bob Luce: Not so far.
Comment:	Lu: I want to go on record outlining a suggestion to carry out a continent wide habitat study. The objective is to evaluate areas with foxes and compare a number of parameters with areas that do not have foxes. Particular emphasis is to be placed on human activities at different sites that may influence fox survival. Such activities would range from coyote control to grazing regimes and habitat modification.
Question:	who? Is the habitat committee going to define suitable habitat?
Response:	Julianne: We will discuss this during the evening evaluation of CACS objectives and strategies.
Question:	Kyran: Why not model habitat use vs availability, like Axel is doing, and extrapolate over the whole range?
Response:	Christiane: There is too much variation over the whole range.
Comment:	Axel: You could overlay the habitat information with all the survey work that has been done.
Response:	Julianne: There is a problem with this strategy, because track surveys are targeted to the most suitable habitat, and we are not surveying habitat in proportion to its availability.
Response:	Axel: It would have to be a randomized study.

Research Committee - Marsha

Marsha reported that the research committee needs more participation by Team members to serve on the committee. Currently the committee is comprised of Marsha and Christiane. Lu and Axel volunteered to assist with the committee. There needs to be at least one more Team member to serve on this committee. Any Team members interested should get with Marsha or Christiane. Originally, the committee was set up to review proposals and allocate funding from a grant received back in 1995-96. The research committee also reviews proposals, provides expertise on writing proposals, and assists with statistical analysis of data. Additionally, the committee has been coordinating and compiling information from several swift fox research projects. Marsha stated that she needed to reevaluate how much support the Northern Prairie Wildlife Research Center can offer at this time. Marsha suggested that if anyone is going to start any swift fox related research, to please contact her or Christiane for ideas and coordination.

The research committee has been evaluating swift fox monitoring surveys that can be used over large geographic areas with limited resources as long-term survey tools. State of the art for finding out how many animals are out there is limited. We are not going to be able to count swift fox. Instead, we will have to rely on estimates from mark-recapture, or more likely from indices of relative abundance of population estimates and density. The research committee is trying to determine what level of detection will tell you there has been a change in population

abundance. The committee has summarized the research to date. Every state is not going to be able to do the same kind of survey. States will have to tailor their surveys to match their environmental conditions and financial situation.

Telemetry techniques provide the most information about survival rates and productivity, and allow you to keep a handle on what is going on demographically and with population growth. Financially, this type of telemetry study is not practical on a broad scale. Next preference would be to use mark-recapture/mark-re-sight techniques, which can be very unreliable. Quality of data is very important. In order for these techniques to be accurate, you really need to mark a majority of the population, and they involve direct handling of the animals. Trap happy and trap shy animals are a problem with swift fox.

In terms of population index methods, **scent stations** are the most popular. But you also get scent station happy and shy animals. It is, however, a good method. You must consider weather conditions, station substrate and bait. For a thorough review of scent station methodology, read Sargeant et al. 1998. Also, Doug Johnson has a Journal of Wildlife Management paper that should be read if you are going to use scent stations. A high visitation rate is needed in order to measure changes in that rate, therefore you need to do whatever you can to increase the visitation rate. Sand and oil is much more effective that chalk plates. Scent station visitation rates are also highly variable with season. Unfortunately, nobody is getting visitation rates high enough to detect population level changes. The visitation rates being achieved are 30% at best. Continuing a survey method because we have several years of similar data is not a good reason to continue. It is better to change methods now rather than later.

Carnivores are not easy to survey. Comparing data between techniques and within a technique, that work differently in different geographic areas is difficult. We need to define what are the goals of the monitoring project. If you are looking for distribution or changes in density, then design the study accordingly. Remember, when doing scent stations, lines are the sampling unit and not stations: the individual stations are not independent. **Trap surveys.** Why do them? They have higher cost, involving handling the animals, and you don't get any more useful information than scent stations provide, unless you are collecting other information from the animal in hand. **Spot light surveys.** These are easy, cheap, cover large area, are non-invasive; but detection rates are extremely low, terrain and vegetation affect visibility, and they just don't work well. **Track surveys.** Kansas, Oklahoma, Colorado, and Nebraska did track surveys in every other township within the swift fox range. This winter Marsha will be analyzing three years of data from Kansas and two years from Oklahoma to determine how much we can trim the survey down. Through modeling we can get the survey down to an effective method that is cheap and doesn't take much time. Hopefully we will be able to come up with some specific recommendations soon. Eric Gese's Colorado study with scat deposition surveys worked well for coyote, but it isn't working for swift fox.

Robert Harrison of University of New Mexico described his work on a scat DNA survey.

They can identify the individual animal through scat and can therefore do mark-recapture with scat. There is tremendous potential here for a successful survey technique. Scats are easy to find in New Mexico. Robert picked up 35 scats in a few hours. They are currently developing lab techniques now. The main limitation if finding a lab to do the work. Research labs want a research project to go with it. This technique is not expensive: it is costing $6,000 to develop the techniques, analyze the blood from captive foxes and process 225 scats. You can tell individual animals apart with microsatellite DNA. The technique will produce relative and absolute indexes. Robert has USGS funding for his pilot study in New Mexico. Since the humidity in New Mexico is so low, the scats can just be collected in dry bags. The scats have already been laying out exposed and are dried out. Robert didn't yet know what preparations will be necessary for the lab work. He is very confident this will work for swift fox since it works for so many other species. The technique exists, we just need to develop the microsatellite primers for each species.

Comment: Pete: What do we want, what are we likely to get, and what are we going to be looking at over the long-term as far as quality of data? You need to think about it in terms of what is really important and realistic. We are going to make an argument on the status of the species largely on the continuity of populations and presence and absence. And maybe that is where we ought to be - presence/absence by county - with some additional qualifiers. But we're never going to have density information. We are not ever going to have anything close to that. We're never going to have the research.

BREAK (dinner)

Team's 1999 Progress Toward Conservation Strategy Objectives

Julianne began the discussion by reviewing the Action items from the Conservation Strategy document that were scheduled form completion by 1999. Oklahoma, Kansas and South Dakota provided written summaries of their individual state status on these items. The Team as a whole agreed that significant progress had been made on these items. Chritiane recommended that the Team include an update the Team's status in a separate chapter in the annual report, rather than in each individual state report. Each state will need to provide their updates to the annual report editor in time to prepare a strategy evaluation chapter similar to the one in last year's report.

Action Items scheduled for Completion in 1999

3.3.1. Research technical committee plan for methodology to state working groups - Marsha updated the Team at the 1998 coordination meeting that there a quite a few different methodologies being used to monitor foxes, and there is currently no consensus on what methodology all states should use to monitor foxes.

3.1.2. State Wildlife Agencies will coordinate and implement monitoring activities for existing resident populations.
3.1.3. Those states that maintain a legal harvest will evaluate feasibility of initiating pelt tagging and mandatory carcass collection.
5.1.1. Development of habitat criteria by Team. Habitat literature review was completed in 1997. Criteria need to include representative descriptions of occupied habitat and prey availability within the species range.
5.1.2. Each state wildlife agency will coordinate with other government and private landowners to conduct habitat surveys and inventories.
5.1.3. Each state wildlife agency will delineate available habitat on state cover maps.
8.1.1. SFCT and state working groups are to provide swift fox distribution and suitable habitat information for prairie ecosystem mapping efforts and GAP analysis to cooperating federal agencies, universities, and conservation organizations.

Action items scheduled for completion by 2002 are focused on the habitat objectives and strategies.

Question: Lu: Do states have resources to do this?
Response: Christiane: There will be overlap among species on some of these actions and so they can be consolidated.
Comment: Brian: Technology has improved and many of these 2002 action items can more easily be done now than they could 3 years ago. These actions are of medium priority.
Comment: Mike Fritz: Standard management guidelines will need to be regional or state specific as differences in habitat and population levels exist.
Comment: Brian: States have done well with the action items under objectives 3 and 5. Now it is time to move onto the habitat objectives and strategies. We really can't go any farther until the habitat strategies are completed. We can still accomplish these action items within the time frame allowed.

Action items scheduled for completion in 2002

6.1.1. Each state wildlife agency will coordinate with the federal and state land management agencies to evaluate current levels of legal protection of native grasslands located within federal and state ownership.
6.1.2. Each state wildlife agency will initiate habitat protection agreements with other government agencies for public land as habitat needs are identified.
6.1.3. Each state is to identify and delineate habitat corridors and surrounding areas between habitat blocks based on the spatial location of suitable habitat that is available to be managed for swift fox, in order to direct conservation measures, agreements or enhancement efforts.
6.2.1. State and federal wildlife agencies are to initiate land conservation or protection measures under current lands programs as limited by priorities and within funding ability, or are to

consider creating a lands program with new or redirected funding sources. Agencies will investigate the feasibility of partnerships with the private sector. On identified critical private lands state agencies should utilize conservation easements or agreements, leases, donations, exchanges or acquisitions. An evaluation and prioritization process of private lands in areas identified to implement land conservation efforts will be initiated.

6.2.2. Implement methods and techniques to gain and maintain cooperation with private landowners that may (will) influence range management practices, through state extension agents, federal grazing leases, and NRCS range specialists. Efforts will be directed primarily at occupied habitat and secondarily at available suitable habitat.

7.2.1. Create a technical committee to review available scientific literature on interspecific competition and applicable control methods. The committee will provide information and recommendations to state wildlife and federal land management agencies as guidelines.

7.2.2. The SFCT and state working groups will review and incorporate information from scientific investigations that address the adaptability of swift fox to colonize non-native habitats and which evaluate the species ability to maintain itself in these habitats.

7.2.3. The SFCT and state working groups will identify and report new, continuing or diminishing threats to swift fox population expansion.

9.1.1. The SFCT and state working groups will collect and compile current technical literature and management information for distribution through information requests from state and federal managers and other interested individuals.

9.1.2. The SFCT and state working groups are to provide recommendations on standard management guidelines, beneficial range management practices for swift fox, methods for data collection/database management, and current information on swift fox ecology, management, and research to wildlife and land managers, government entities, land planners, state and federal policy makers.

9.1.3. The SFCT will consider cooperating on a joint publication that promotes the scientific basis for conserving prairie species, including swift fox, for distribution to wildlife and land managers. If it is determined that this document is needed and jointly supported, funding will be solicited from cooperators and partners.

Swift fox symposium status update.

Lu: Six papers are ready for copy editing; 9 are in peer review and 5 have not been received yet. February 15 is when copy editing begins. NPWRC is preparing the manuscripts for copy editing to save money. Still need good photographs. Target audience is more than the scientific community. Therefore, we need to make the proceedings attractive. Also need to standardize the illustrations. This is more than the proceedings of the symposium. This is a book on swift fox. Anybody can still make a major contribution. Topics include: Conservation (5 papers); status (4 papers); taxonomy physiology and disease (5 papers); census techniques (4 papers); population ecology (6 papers); miscellaneous (2 papers); behavior (3 papers). All papers are peer reviewed. Two papers have been rejected. As always we could use more money. We will probably have to charge page charges. But, we are still accepting donations. Tarren Wagener offered funds for the book. Slides or prints will work for photographs. There is still

some species at risk money from a couple of years ago. The proceedings will probably not be available in electronic format. We need a paper on habitat based on the discussion we just had this evening.

Administrative Details for 2000

Team Chair - Julianne will serve one more year as Team Chair.

1999 Annual Report - Greg Schmitt volunteered to edit the 1999 Annual Report. Julianne will assist Greg.

Annual Coordination Meeting 2000 - The 2000 meeting is supposed to be the 2-day meeting with a field trip. Greg offered New Mexico as an option - Albuquerque is 150 miles from swift fox habitat but is the best place to get in and out of. Eileen offered South Dakota to host the annual meeting. No decision was made on the month that would work best for the annual meeting. The prairie dog group's annual meeting is supposed to take place in December each year. Julianne suggested that if we don't coordinate with prairie dog group, we need to change month so that out-of-state travel will be easier to obtain for some Team members. Christiane suggested that if we do meet in coordination with the prairie dog group, we need to have joint session. One concern with tying the two meetings together is making sure that the Team-specific representatives can attend their respective meetings. We don't want to get into a situation where an agency sends one person to both meetings, if they don't serve as Team representative for that agency on that Team. Five team members serve as their agency's representative on both the prairie dog and swift fox teams (Wyoming, Nebraska, Oklahoma, Texas, and New Mexico). All agreed that making the meeting cheap to attend and in an area that is easy to fly into makes the difference on whether travel requests are approved or denied. No final meeting decision was made on either location or dates. Tentatively, the group agreed to New Mexico for 2 days, possibly in early October.

The Team thanked the Arizona Game and Fish Department for picking up the meeting room tab and making meeting arrangements. Julianne sent a thank you letter to Bill Van Pelt with Arizona Game and Fish on behalf of the swift fox Team thanking Arizona Game and Fish for their support and assistance with the meeting. The meeting was adjourned at 8:30 pm.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services
420 South Garfield Avenue, Suite 400
Pierre, South Dakota 57501-5408

December 9, 1999

Ms. Julianne W. Hoagland
Swift Fox Conservation Team Chair
Department of Oklahoma Wildlife Conservation
1801 North Lincoln
P.O. Box 53465
Oklahoma City, Oklahoma 73152

Dear Julianne:

This letter is in reply to your correspondence of this past year and the interest of the various involved States in the status of the candidate species review for the swift fox. I apologize for the delay in this response, but our listing priority guidance has not allowed timely involvement in this issue. Our office was assigned responsibility for the response to a recent black-tailed prairie dog petition. Accordingly, most of our resources have been expended on this large work effort. Fish and Wildlife Service (Service) guidance prioritizes responses to petitions over candidate species review. Staff shortages, vacancies, and pending retirements have compounded our work backlog. Work reassignments among staff have focused on the most pressing resource issues, including endangered species concerns.

Fortunately, contract assistance from Marsha Sovada with the Biological Resources Division of the U.S. Geological Service has resulted in near completion of a recent candidate species review for the swift fox. I have reviewed the latest version and have forwarded it to our Denver Region 6 Office for their review and further coordination with the Albuquerque Region 2 Office. I understand that the package will likely be forwarded to our Washington Office early next year. I want to emphasize that any decision regarding the listing status of the swift fox will be made by the Director of the Service. Any recommendation from a Service Field Office in matters such as these is subject to additional review by other Field Offices, Regional Offices, the Washington Office, and finally by the Director.

I congratulate the Swift Fox Conservation Team on its efforts over the past few years. Certainly, more information about the distribution and abundance of the species, as well as its ecology, has been important in the development of our recommendation. Thank you for your efforts as the Team Chair.

Sincerely,

Pete Gober
Field Supervisor
South Dakota Field Office

cc: Swift Fox Team Representatives
State Wildlife Directors in R2 and R6
R2 and R6 ES Field Offices
R6 NGARD and SGARD Offices
R2 and R6 ARD ES Offices
R2 and R6 Endanger Species Offices
GARD-Northern Ecosystems; Denver, CO (60101)
(Attention: Susan Linner)

SWIFT FOX CONSERVATION TEAM
revised 8-28-00

STATE AGENCIES:

Colorado
Jennie Slater
Colorado Division of Wildlife
6060 Broadway
Denver, CO 80216
Phone: 303-291-7367
FAX: 303-291-7114
email: **jennie.slater@state.co.us**

Kansas
Christiane Roy
Kansas Dept of Wildlife and Parks
1830 Merchant Box 1525
Emporia, KS 66801-1525
Phone: 316-342-0658 ext. 202
FAX: 316-342-6248
email: **christir@wp.state.ks.us**

Montana
Brian Giddings
Montana Fish Wildlife and Parks
PO Box 200701
Helena, MT 59620-0701
Phone: 406-444-0042
FAX: 406-444-4952
email: **bgiddings@state.mt.us**

Nebraska
Richard Bischof
Nebraska Game and Parks Commission
2200 N. 33rd
Lincoln, NE 68503
Phone: 402-471-5419
FAX:
email: **rbischof@ngpc.state.ne.us**

New Mexico
Greg Schmitt
New Mexico Dept of Game and Fish
PO Box 25112
Santa Fe, NM 87504
Phone: 505-827-9925
FAX: 505-827-9956
email: **gschmitt@.state.nm.us**

North Dakota
Vacant
ND Game & Fish Department
100 N. Bismarck Expressway
Bismarck, ND 58501
Phone: 701-328-6338
FAX: 701-328-6352
email:

Oklahoma
Julianne Whitaker Hoagland
Oklahoma Dept of Wildlife Conservation
1801 N. Lincoln Blvd
Oklahoma City, OK 73105
Phone: 405-522-0189
FAX: 405-521-6535
email: **jhoagland@odwc.state.ok.us**

South Dakota
Eileen Dowd Stukel
South Dakota Dept Game, Fish and Parks
523 E Capitol
Pierre, SD 57501
Phone: 605-773-4229
FAX: 605-773-6245
email: **eileen.dowdStukel@state.sd.us**

Texas
Robert Sullivan
Texas Parks and Wildlife Department
P.O. Box 659
Canyon, TX 79015
Phone: 806-655-3782/3975
FAX:
email: **robert.sullivan@amaonline.com**

Wyoming
Bob Oakleaf
Wyoming Game and Fish Department
Boakle@state.wy.us

FEDERAL AGENCIES

U.S. Fish and Wildlife Service
Pete Gober
USFWS Ecological Service
420 S. Garfield Suite 400
Pierre, SD 57501
Phone: 605-224-8693 ext 24
FAX: 605-224-9974
email: **p_gober@fws.gov**

U.S.G.S./Biological Resources Division
Marsha A. Sovada
Northern Prairie Wildlife Research Center
8711 37th Street SE
Jamestown, ND 58401
Phone: 701-253-5506
FAX: 701-253-5553
email: **marsha_sovada@usgs.gov**

U.S. Forest Service
Bob Hodorff
U.S. Forest Service
Fall River Ranger District
209 North River Street
Hot Springs, SD 57747
Phone: 605-745-4107
FAX: 605-745-4179
email: **rhodorff@fs.fed.us**

U.S.D.A. APHIS-Wildlife Services
Jeffrey S. Green
USDA APHIS-Wildlife Services
12345 W Alameda Parkway #204
Lakewood, CO 80228
Phone:
FAX: 303-969-6578
email: **Jeffrey.s.green@usda.gov**

Bureau of Land Management
Mark Hilliard
BLM
1387 S. Vinnell Way
Boise, ID 83709
Phone: 208-373-4040
FAX:
email: **Mark_Hilliard@blm.gov**

National Park Service
Dan Licht
NPS
1709 Jackson St.
Omaha, NE 68102
Phone: 402-221-3603
FAX: 402-221-3480
Email: dan_licht@nps.gov

CANADA

Steve Brechtel
Alberta Fish and Wildlife Division
9945-108 Street
Edmonton, AB T5K 2G9
Phone: 403-422-9535
FAX: 403-422-9785

Team Chairs
Julianne Hoagland - Oklahoma
Vacant

Committee Chairs
Research - Marsha Sovada - USGS
Habitat - vacant
Reintroduction - Eileen Dowd Stukel - SD
Education -Christiane Roy - Kansas

SWIFT FOX CONSERVATION TEAM

PARTICIPATING COOPERATORS

revised 12/31/99

Lu Carbyn
Canadian Wildlife Service
4999 98th Avenue
Edmonton, AB T6B 2X3
Phone: 403-435-7357
FAX: 403-435-7359
email: **lu.carbyn@ec.gc.ca**

Tarren Wagener
Fort Worth Zoo
1989 Colonial Parkway
Fort Worth, TX 76116
Phone: 817-871-7487
FAX: 817-871-7012
email: **TKWagener@aol.com**

Michael Fouraker
Fort Worth Zoo
1989 Colonial Parkway
Fort Worth, TX 76110
Phone: 817-871-7418
email: zoocons@aol.com

Robert Harrison
University of New Mexico
Dept. of Biology
Albuquerque, NM 87131
Phone: 505-277-3411
FAX: 505-277-0304
email: rharison@unm.edu

Fred Lindzey
Wyoming Coop Unit
Box 3166
Laramie, WY 82070
Phone: 307-766-5415
FAX: 307-766-5400
email: **flindzey@nw40.edu**

Bill Andelt
Department of Fishery and Wildlife Biology
Colorado State University
Fort Collins, CO 80523
Phone: 970-491-7093
FAX: 970-491-5091
email: **billan@picea.cnr.colostate.edu**

Axel Moehrenschlager
Calgary Zoo
PO Box 3036 Station B
Calgary, AB T2M 4R8
Phone: 403-232-7771
email: **axecyn@telusplanet.net**

Greg Linscombe
Fur Resources Committee
Internat Assoc of Fish & Wildlife Agencies
Louisiana Dept. of Wildlife and Fisheries
2415 Darnell Road
New Iberia, LA 70560
Phone: 318-373-0174

Kyran Kunkel
Turner Endangered Species Fund
PO Box 190
Gallatin Gateway, MT 59730
Phone: 406-763-4419 ext. 3008
FAX: 406-763-4801
email: **tesf2@montana.net**

Kevin Honness
Turner Endangered Species Fund
112 N Popler Ave #2
Pierre, SD 57501
Phone: 605-945-2655
email: honness@cam-walnet.com

Clio Smeeton
Cochrane Ecological Institute
PO Box 484
Cochrane, AB T01 0W0
Phone: 403-932-5632
FAX: 403-932-6303
email: **cei@cadvision.com**

Minette Johnson
Defenders of Wildlife
114 West Pine Street
Missoula, MT
Phone: 406-549-4103
FAX:
email: minette@bigsky.net

SUMMARY OF SWIFT FOX RESEARCH NEAR MEDICINE BOW, WYOMING - SUMMER 1999

Travis L. Olson and Frederick G. Lindzey, Wyoming Cooperative Fish and Wildlife Research Unit.

INTRODUCTION

During the summers of 1997 and 1998 we conducted trials designed to estimate the probability of detecting swift fox presence using tracking plate transects when swift foxes were known to be present (Olson et al. 1997, Olson et al. 1998). In late August 1999, trials were repeated using the same sample transects. Our objective was to obtain an estimate of the probability of detecting 1 swift fox of a pair using tracking plate transects placed within a pair's home range. During the summer of 1999 we also monitored home range and habitat use of radio-collared foxes on the study area. Comparison of home range locations with ranges from the previous 2 summers allowed us to investigate the assumption that swift fox home ranges will be filled year to year if the population is not declining. This is the primary underlying assumption associated with using permanently placed tracking plate transects for monitoring swift fox presence over time.

STUDY AREA

This study was conducted on the southern edge of the Shirley Basin in northwestern Albany County, near Medicine Bow, Wyoming. The study area covered approximately 220 km^2, at an average elevation of 2075 m (6800 ft). Plant communities consisted of sagebrush steppe and mixed grass prairie. Habitat was primarily grass dominated, interspersed with patches of low-growing (<1 m) sagebrush (*Artemisia*) and taller greasewood (*Sarcobatus vermiculatus*). Topography of the area was mostly flat with numerous dry lakebeds and several saline lakes. The climate of the area was characterized by long, cold, snowy winters and warm, dry summers. Precipitation averaged 26 cm (10.3 in), including 59 cm (23 in) of snow annually (Pers. Comm. Medicine Bow town office). Other predators present were badgers (*Taxidea taxus*), coyotes (*Canis latrans*), golden eagles (*Aguila chrysaetos*), and ferruginous hawks (*Buteo regalis*). No red foxes (*Vulpes vulpes*) were seen on the study area during the course of study. White-tailed prairie dog (*Cynomys leucurus*) colonies of variable size were found on the study area. Land ownership was mostly private and the primary land use was cattle grazing. Human developments consisted of fences, windmills, stock ponds, and secondary roads.

METHODS

Swift foxes were captured on the study area between January and May for 4

consecutive years (1996 - 1999). We captured swift foxes using Tru-catch live traps baited with butcher scraps (Dieni et al. 1997). Previously collared foxes were targeted for recapture, and old collars were replaced. After old foxes were recaptured, the remainder of the study area was trapped for new foxes. Traps were checked twice nightly to minimize the time a female might be kept from her pups. Each captured fox was ear-tagged and fitted with a radio collar (Advanced Telemetry Systems Inc., Isanti, MN), weighed, and released. Foxes captured in 1998 and 1999 were marked with colored ear-tags, and a unique combination of colored tape on the radio-collar to allow visual recognition of individuals.

Home range use of collared foxes was monitored during the late spring/summer from 1997-1999 using radio telemetry. During late spring/summer of 1997 we triangulated swift fox positions at night using a combination of a roof mounted omni antenna and a hand held "H" antenna. We used at least 3 intersecting azimuths per location. The observer's position was determined from USGS 1:24000 scale topographic maps. We estimated home ranges for each pair of foxes in 1997 from telemetry locations, and from the average activity radii of male swift foxes (plus 1 SD, Pechacek et al. unpublished manuscript). During late spring/summer of 1998 and 1999 we located swift foxes at night using 2 truck-mounted telemetry towers equipped with 2, 3-element yagi antennas joined with a null / peak box. Each truck was located at a known position and simultaneous bearings were taken from each truck toward a radio-collared fox. We then used the computer program Locate II (version 1.3) to triangulate fox locations. We estimated fox home ranges (adaptive kernel method, 95 % utilization distribution) for the summer of 1998 and 1999 using the program Ranges V.

Two test trials were run for 7 days each during the summer of 1997 to estimate the probability of detecting 1 fox from a marked pair, using tracking plates (Olson et al. 1997). Transects, 1 km (0.6 mi.) in length and consisting of 4 stations separated by 0.3 km (0.2mi), were placed within or near the core use area of each pair (50 % utilization distribution) and in the area where overlap with adjacent foxes was absent or minimal. We purposely avoided areas of overlap with adjacent fox pairs to minimize the number of adult foxes which would likely encounter each transect. Transects were placed in selected locations (e.g., along fence lines, road intersections) to increase the likelihood of fox visitation. Each station consisted of a 61cm x 61cm (2 ft x 2 ft) tracking plate (sheet steel) and an infra-red, remotely triggered camera (TrailMaster TM 1500, Goodson and Assoc. Inc. Lenexa, KS). Tracking plates were sprayed with a talcum powder-ethanol mixture, leaving a thin coat of talc on the plate, and baited with approximately 5 g of canned mackerel in the center of the plate (Woolley et al. 1995). We started each trial on a day forecasted to be dry because rain would have destroyed the tracking medium (talc). Mackerel was used as an incentive for the foxes to re-visit the plates. Cameras were triggered when an infra-red beam of light centered across the plates was broken, allowing us to identify foxes (marked or unmarked) that visited plates from photographs. If a photograph showed a marked fox, we assumed (in 1997) the fox was one of the pair in whose core area the transect was located. Tracking plates were checked each morning, and swift fox tracks were measured and recorded. Plates were re-baited later that day (early evening). Number of photographs taken each night was recorded, and film was replaced as needed.

The transect / fox pair was the sample unit, and the proportion of transects detecting presence of marked swift foxes during each trial was considered the detection estimate. We constructed approximate 95% confidence intervals for detection probability estimates as described by Johnson and Kotz (1969). We ran the same 9 transects in 1998 as we had in 1997 but added 1 additional transect in an area where we did not have a radio-collared fox pair in 1997. All 10 transects were run in 1999. By running the same transects each year we hoped to test the assumption that home ranges will be filled from year to year if the population is not declining. Running the same transects also simulated how we suggested a monitoring program be operated from year to year in state-wide application. Of the initial transects run in 1997, we determined which transects were still located within a swift fox pair's home range each year and used data from those transects to estimate detection probabilities in 1998 and 1999.

RESULTS

We captured 28 swift foxes on the Medicine Bow study site between 14 Jan and 15 May 1999. Of these, 13 were previously collared and 15 were new foxes. By the end of August 1999, 9 of the collared foxes had died, 5 were missing, and 14 were still alive on the study area. Mortality was primarily due to coyote predation (7 of 9), but one fox was apparently killed by a raptor, and one died from canine distemper virus.

See Olson et al. (1997, 1998) for detailed results from the summers of 1997 and 1998. Of the 10 transects run in late August 1999, only 8 were still located within swift fox home ranges. We detected swift fox tracks on 5 of those 8 transects (0.63) after 7 days (Table 1). We also obtained photographs of foxes on 2 transects where we did not detect tracks. On one transect where we obtained a photograph but did not detect a track, the photograph showed a fox on the plate, but due to damage of the tracking medium by rain we could not distinguish the track. Based on detection results from both cameras and tracking plates, we detected swift foxes on 7 of the 8 transects (0.88) where foxes were known to be present (Table 1).

Table 1. Swift fox detection probability estimates using tracking plate transects near Medicine Bow, Wyoming 1997-1999.

Detection Type	Probability (95% CI)			# Days		
Year	97	98	99	97	98	99
Tracks on Plates	0.88 (0.47-1.0)	0.88 (0.47-1.0)	0.63 (0.24-0.91)	6	6	7
Tracks and photographs	1.0 (0.63-1.0)	0.88 (0.47-1.0)	0.88 (0.47-1.0)	6	6	7

Of the 9 transects that were within home ranges in 1997, 7 were still in home ranges in 1998 (Table 2). Of the 8 transects that were within home ranges in 1998, 6 were still in home

ranges in 1999, and of the 9 transects that were within home ranges in 1997, 7 were still in home ranges in 1999. Table 2 displays which transects were located within home ranges each year, and detection results for each transect. If the detection method is able to detect foxes with a high probability when present, we expected to detect swift fox presence if the transect was located within a pair's home range. This pattern generally held with the exception of transect number 1 Table 2).

The number of collared swift foxes on the study area during the late August trials was similar during the 3 years of this study (Table 3). However, there were fewer new foxes in 1999 than in 1998 (27 % vs. 70 %).

Table 2. Summary of swift fox detection results using tracking plates transects and cameras from trials conducted in late August 1997-1999 near Medicine Bow, Wyoming.

	In home range			Track Detection			Photograph Detection		
Transect #	97	98	99	97	98	99	97	98	99
1	Y	Y	Y	N	N	N	Y	N	Y
2	Y	Y	N	Y	Y	N	Y	Y	N
3	Y	Y	N	Y	Y	N	Y	Y	N
4	Y	Y	Y	Y	Y	N	Y	Y	Y
5	Y	Y	Y	Y	Y	Y	Y	Y	N
6	Y	N	Y	Y	N	N	Y	Y	N
7	Y	Y	Y	Y	Y	Y	Y	Y	Y
8	Y	N	Y	Y	N	Y	Y	N	Y
9	Y	Y	Y	Y	Y	Y	Y	Y	Y
10	NA	Y	Y	NA	Y	Y	NA	Y	Y

Table 3. Number of collared foxes present on Medicine Bow, Wyoming study area during late August 1997-1999.

Year	1997	1998	1999
# Collared Foxes	13	17	15
# Foxes From Previous Year		5	11
% New Foxes		70%	27%

DISCUSSION

Estimated swift fox detection probability using tracking plate transects was slightly lower in 1999 than the previous 2 years. However, the estimate for 1999 (0.63), falls within the 95 % confidence interval (0.47-1.0) for the detection rate from the previous 2 years. One possible explanation for lower detection in 1999 is that there was a lower turnover in the

population between 98 and 99 than between 97 and 98. This resulted in more older foxes that were exposed to tracking plate/camera stations the previous year. Older foxes may be more wary and therefore less likely to step on tracking plates.

Generally, swift fox pair home ranges were filled from one year to the next on our study area. Each year, 2 ranges from the previous year were not filled, however the 2 ranges that were vacant in 1998 were filled again in 1999. This seems to strengthen the assumption that swift fox home ranges will be filled from one year to the next if the population is not declining. That we observed a high turnover rate in the population (especially from 1997 to 1998), yet maintained foxes within home ranges, indicates that areas selected as home ranges by previous foxes are also chosen by new foxes. This further strengthens the assumption that ranges will be filled if the population is not declining.

LITERATURE CITED

Dieni, J. S., F. G. Lindzey, T. P. Woolley, and S. H. Anderson. 1997. Swift fox investigations in Wyoming: Annual report. Wyoming Cooperative Fish and Wildlife Research Unit, Laramie, Wyoming, USA.

Olson, T. L., J. S. Dieni, F. G. Lindzey, and S. H. Anderson. 1997. Swift fox detection probability and implications toward population monitoring. Unpublished manuscript. Wyoming Coop Research Unit. Laramie, WY. 19 pp.

Olson, T. L., F. G. Lindzey, and J. S. Dieni. 1998. Swift fox detection probability in southeast Wyoming. Wyoming Cooperative Fish and Wildlife Research Unit. Laramie, WY. 16 pp.

Woolley, T. P., F. G. Lindzey, and R. Rothwell. 1995. Swift fox surveys in Wyoming – Annual report. Pages 61-76 *in* S.H. Allen, J. Whitaker Hoagland, and E. Dowd Stukel, eds. Report of the swift fox conservation team 1995. Bismarck, ND.

SWIFT FOX COMPLETION REPORT

Bob Luce, Lee Hunt, and John Priday, Wyoming Game and Fish Department.

STATE OF WYOMING NONGAME MAMMALS – Species of Special Concern

PERIOD COVERED: 16 April 1999 – 15 April 2000

INTRODUCTION

The swift fox monitoring project will occur in two phases.

The purpose of the distribution survey conducted in 1999, and of surveys planned for 2000, was to document known locations of swift fox (*Vulpes velox*) in the current range in Wyoming. Baited track plates placed in a continuous transect up to several miles long with a track plate spacing of 1.6 km (1 mi) between plates was found to be the most effective method for documenting swift fox in areas with potential habitat but unknown population status (Dieni et al. 1997).

Surveys to develop baseline transects for monitoring long-term population trends will begin in 2001. These trend surveys will occur in locations documented to have swift fox during the 1999 and 2000 distribution surveys. The University of Wyoming Cooperative Fish and Wildlife Research Unit developed the survey method, which will be used during this project (Olson et al. 1999). The trend transects will use a more intensive survey method (five track plates at a spacing of .8 km (.5mi) between plates). Approximately 20 transects will be surveyed in each of three geographic region with each transect no closer than five miles to another. The method is based on the assumption that there is an 88% probability that a fox documented in a location will remain in or return to the same location the following year (Olson et al. 1999).

Repetition of the 2001 surveys in 2006 will document the long-term trend for the species.

According to Woolley et al. 1995, the current population occurs primarily in three geographic regions: 1) Laramie Valley and Shirley Basin in Albany and Carbon counties, 2) Southeastern Plains–parts of Laramie, Platte and Goshen counties, and 3) Powder River Basin-parts of Converse, Natrona, Weston and Niobrara counties. Surveys were conducted in the Laramie Valley and Shirley Basin areas in 1999. The second and third regions will be surveyed in 2000.

METHODS

Track plates were made of 16-gauge sheet steel, measured 61cm x 61cm (2ft. x 2ft.) painted with two coats each of gray primer and gray paint. A one-gallon weed sprayer was used to coat the plates with talc and ethyl alcohol mixture, the ratio used was 2.5 cups talc: 1 gallon 95% ethyl alcohol. This mixture will prepare 40-50 plates. Approximately 15g of stirred jack mackerel were placed in the center of the plate as an attractant. Plates were spaced 1.6 km (1 mi) apart within public road easements where tracks could be observed without requiring private land access. Track plates were placed along an existing fence if one was present. When a fence was not present, plates were placed 10 m to 25 m from the centerline of the road.

Road kill observations were recorded and used as locations for initial sampling. The location of each plate was marked by flagging on the fence or a stick flag, and a GPS location in UTM coordinates was recorded for the center track plate of each transect. Track plates were observed for a maximum of four nights. Track plates were picked up for five miles on either side of a swift fox track occurrence after the first night swift fox use was documented to prevent duplicate recordings of the same animal (Olson et al. 1998). During periods of heavy rain plates were left in-place for up to five nights.

When a swift fox track was identified, track measurements were recorded and lifted for future reference with 2-inch clear packing tape. In some cases, clear contact paper was used to preserve an entire track plate for future use in identifying tracks. Plates were cleaned with a stiff brush or steel wool before reuse.

Baseline trend transects used during the 2001 trend monitoring survey will be those transects with positive identification of a swift fox track on a track plate during the 1999 and 2000 surveys. Where known den sites along roads are recorded those locations will be used as center locations for baseline transects.

RESULTS

Surveys from 18 August through 18 September 1999 attempted to sample all potential swift fox habitat (grasslands and grasslands with low shrub coverage) in Albany (Laramie River Valley) and Carbon Counties (Shirley Basin). Twenty-four transects (371 track plates) ranged from 5 – 32 km (3 – 20 mi) long. Total linear sample was 1304 km (815 mi). In Albany County, 15 transects (218 track plates) produced 58 locations and 9 transects (153 track plates) produced 12 locations in Carbon County. Thirteen hundred seventy-one (1371) track plate nights were recorded. One hundred eighty six (186) track plate nights were subtracted due to rain, leaving 1185 functional track plate nights.

Transect routes that detected swift fox were identified the first night except for three transects which needed two, two, and three nights, respectively, to detect a swift fox. Twenty-four discrete swift fox locations were documented and will serve as baseline transects during the trend survey in 2001 and 2006 (Table 1).

Four separate den locations were documented while conducting track plate surveys. When a track plate location and a den site occurred within 8 km (5 mi) of each other the den site was used as the baseline location rather than the track plate location. These observations were included in the list of baseline transect locations (Table 1). A total of eight road killed swift fox were found during surveys, four of which were within 300 m (.2 mi) of a track plate location.

Swift fox tracks on 70 track plates ranged from 21mm – 28mm wide; averaging 24mm, the lengths ranged 27mm – 35mm long averaging 31mm. Tracks found at the entrance to a swift fox den in soft sand measured 35mm x 50 mm. Mud surrounding a stock pond produced tracks 27mm wide x 40mm long. Other tracks found on track plates included: coyote (*Canis latrans*), domestic dog (*C. familiaris*), bobcat (*Lynx rufus*), domestic cat (*Felis domesticus*), red fox (*Vulpes. vulpes*), badger (*Taxidea taxus*), striped skunk (*Mephitis mephitis*), long-tailed weasel (*Mustella frenata*), white-tailed jackrabbit (*Lepus townsendii*), cottontail species (*Sylvilagus sp.*), white-tailed prairie dog (*Cynomys leucurus*), unidentified ground squirrels, mouse species, tiger salamander (*Ambystoma tigrinum*), sage grouse (*Centrocercus urophasianellus*) and other small prairie birds.

DISCUSSION

Surveys for swift fox in 1999 were designed to establish a sufficient sample size of known fox locations to serve as baseline trend transect locations for subsequent years. Short and mixed grass prairies mostly devoid of heavy shrub coverage characterized areas where swift fox were most commonly found. Selection of survey routes took into account random swift fox observations made during black-footed ferret spotlight surveys and prairie dog density transecting in Shirley Basin, and random observations by USDA -Wildlife Services, Wyoming Game and Fish Department, and Wyoming Cooperative Fish and Wildlife Research Unit personnel.

In contrast with other prairie mammals in Wyoming swift fox tracks demonstrated unique characteristics. Swift fox tracks were differentiated from red fox in that red fox prints are 15 - 20 mm longer and 10 - 15mm wider. Coyote tracks are similar to red fox though they have slightly wider measurements and less hair between paw pads than do red fox. Claw impressions of canines on track plates are rarely detected compared to tracks of the same animal in softer substrates. White-tailed jackrabbit front tracks were similar to swift fox but distinguishable by the amount hair distorting the shape of toe and palm pads. These tracks looked similar to pressing a cotton ball on the surface of the track plate. Usually the front tracks were accompanied by the much longer hind tracks. Rodents and cows may have affected the number

of fox detections by taking attractant or smudging plates. Since impressions of grassland mammal tracks appear slightly different on track plates than on softer surfaces such as mud, sand, and snow, it is recommended that each project preserve track plates of separate species for comparison.

Eight observations of road mortality were documented while surveying a total linear sample of 1304 km (815 mi). On average one swift fox road mortality was observed for 163 km (102 mi) surveyed. Distribution of road mortality occurrences include: four near one den site, approximately 50 meters from Wyoming State Highway 487 North in Shirley Basin, one on State Highway 77 in Shirley Basin, one on State Highway 287 between Bosler and Rock River, one on a maintained, gravel county road south of Laramie, and one on a two-track dirt road near Wheatland Reservoir No.2.

Swift fox distribution surveys in the year 2000 will be conducted in sample region two (Converse, Natrona, Weston, and Niobrara counties) and sample region three (Laramie, Platte and Goshen counties). Surveys for monitoring population trends will start in 2001. The Wyoming Cooperative Fish and Wildlife Research Unit (Olson et. al. 1999) developed protocol for sampling probabilities of swift fox detection, which includes establishing permanent track plate transects. Recommended transect length is 1.3 km (0.8mi) with five plates spaced evenly (0.2 mi) using locations from Table 1 as the center track plate.

Transects will be observed for a maximum of six days, but monitoring will cease the day after swift fox presence is confirmed. This method is designed to detect declines in the population under the assumption that there is an 88% chance that a fox will remain in or return to the same area from one year to the next. Resurveying the twenty-four baseline locations in the year 2006 will provide swift fox population trends. A stable population will require twenty-one out of the twenty-four transects to have an occurrence.

Recent data on swift fox occurrence is available and these locations will be sampled in the year 2000 surveys. In 1998 the Douglas Ranger District surveyed on and near Thunder Basin National Grassland. These data documented twenty-two suspected swift fox locations (Sidle 1998). Woolly et al. 1995 listed thirty-seven locations of fox observed on track plate and spotlight surveys. Wyoming Game and Fish Department trapper surveys, U.S. Forest Service incidental sightings, and Wyoming Game and Fish Department wildlife observation system records will provide additional locations. Locations near Cheyenne include fox captures made in 1991 for relocation to Canada (Carbyn pers. comm.). From these documentations an adequate sample size (approximately 20 in each region) should be obtainable.

LITERATURE CITED

Dieni, J.S., F. G. Lindzey, T. P. Woolley, and S. H. Anderson. 1997 Swift fox investigations in Wyoming: Annual Report. Wyoming Cooperative Fish and Wildlife Research Unit, Laramie, WY

Olson, T. L., F. G. Lindzey, and J. S. Dieni 1999. A proposed protocol for monitoring swift fox in Wyoming. Unpublished manuscript. Wyoming Coop Research Unit. Laramie, WY. 12pp.

Olson, T.L., F. G. Lindzey, and J. S. Dieni 1998. Swift fox Detection Probability in Southeast Wyoming. Pages 51-65 in C. C. Roy ed. 1998 Swift Fox Conservation Team Annual Report. Emporia, KS.

Sidle, J. 1998. 1998 Swift Fox Survey – Thunder Basin National Grassland – Douglas Ranger District. Pages 75-78 in C. C. Roy ed. 1998 Swift Fox Conservation Team Annual Report. Emporia, KS.

Woolley, T.P., F.G. Lindzey, and R. Rothwell. 1995 Swift Fox Surveys in Wyoming – Annual Report. Pages 61-76 in S.H. Allen, J. Whitaker Hoagland, and E. Dowd Stukel, eds. Report of the swift fox conservation team 1995. Bismarck, ND.

SWIFT FOX INVESTIGATIONS IN NEW MEXICO, 1999

Robert L. Harrison. Department of Biology, University of New Mexico, Albuquerque, NM 87131. rharison@unm.edu

Swift fox (*Vulpes velox*) have been recently found to occur throughout their historical range in eastern New Mexico, with the exception of areas of high shrub density and cropland (Harrison and Schmitt 1997). To further study the population status and general ecology of swift fox in New Mexico, funding for a three-year research project was approved by the New Mexico Department of Game and Fish and the U.S. Fish and Wildlife Service. The primary goal of current research is to determine the method of population census most appropriate for swift fox in New Mexico. Both relative and absolute estimation methods are being examined. Emphasis is placed upon methods which would be most practical for statewide surveys given the limited financial and labor resources of New Mexico. Secondary goals are to study population density, demographic parameters, home range size, diet, den site selection, and threats to swift fox populations.

Activities this year included selecting a study area, mapping land ownership, obtaining permission to study on private and public land, updating landowners on the progress of the study, purchasing and testing telemetry, capture, and handling equipment, trapping and marking foxes, telemetry, data entry, mapping home ranges, scat collection, lure testing, testing methods of surveys for tracks and scats, testing scent stations with automatic cameras, describing den sites, spotlighting, calling, searching for tracks, and discussions and arrangements with genetics laboratories. Summaries of activities and results are presented below. This report describes activities prior to December 1, 1999. Readers of this report should bear in mind that all conclusions presented here are strictly preliminary.

STUDY AREA

The western unit of the Kiowa National Grasslands was selected for the study area, based upon the availability of swift fox, typical swift fox habitat, public roads, and extensive public land. The study area is located northeast of Roy, NM, in Harding and Colfax counties. The extended study area covers approximately 484 square miles. Activities to date have been concentrated within a core area of approximately 128 square miles.

Habitat within the study area is entirely short-grass prairie (described as plains-mesa grassland by Dick-Peddie 1993). Dominant plant species are blue grama (*Bouteloua gracilis*), hairy grama (*B. hirsuta*), western wheatgrass (*Elymus smithii*), threeawn (*Aristida sp.*), and needle and thread (*Stipa comata*). The most common shrubs are broom snakeweed (*Gutierrezia sarothrae*) and *Yucca*. Snakeweed is extensive in some sections, but *Yucca* occurs only in isolated stands. Topography is low rolling hills and elevation varies from approximately 1700 to

1900 m (5570 to 6200'). Annual precipitation averages 429 mm (16.9"), with most precipitation occurring as summer rainfall. Average low and high temperatures are 3.1°C (37.5°F) and 18.8°C (65.8°F), respectively.

The study area includes private, state, and federal lands. Land ownership and grazing permittees within the extended study area were identified and mapped through visits to the State Land Office, Kiowa National Grasslands, and Harding and Colfax County courthouses. Ninety individual landowners and permittees were identified. A letter was written to each landowner and permittee describing the project. Included with the letter was a pamphlet describing swift fox. All twenty-nine private landowners within the core area were then contacted by telephone or letter to request permission to enter their land. Permission was granted by all but two landowners. All landowners within the study area have been identified. A second letter was written later to all ninety landowners and permittees updating them on progress of the study. Permission to use New Mexico State Trust land and Kiowa National Grassland was obtained after submission of the study proposal. In addition, permits to capture and handle swift fox were obtained from the New Mexico Department of Game and Fish and the University of New Mexico Main Campus Animal Care Committee.

METHODS

Two methods to determine the absolute number of foxes within the core study area are being examined: intensive trapping combined with bait stations with automatic cameras, and DNA analysis of scat. Intensive trapping has begun using 25cm x 30cm x 81cm single door traps (Tomahawk Traps, Tomahawk, WI) baited with beef scraps and a cod liver oil - mackerel lure (Trailing Scent, On Target A.D.C., Cortland, IL). Traps are placed at fence, road intersections, or other conspicuous locations and covered with available materials, such as dry weeds or cattle droppings. Captured foxes are transferred to a 30cm x 60cm x 76cm restraint module (Tomahawk Traps, Tomahawk, WI) and sedated before handling. Initially a combination of ketamine (25 mg/kg of body weight) and xylazine (2.5 mg/kg) was used based upon Kreeger (1996), but this resulted in unnecessarily long sedation and depressed breathing and heart rates. Reduction of the dosage to 10 and 1 mg/kg, respectively, did not solve these problems. Telazol (10mg/kg, Kreeger 1996) was found to be more acceptable. It does not depress heart or breathing rates, but may cause excessive salivation and recovery with little warning. Captured foxes are dusted for fleas, inspected for sex and injury, aged (juvenile/adult), measured, fitted with a radio collar (Advanced Telemetry Systems, Isanti, MN, telemetry system described below), and marked for individual visual identification by dying an unique portion of their fur with commercial hair dye (Miss Clairol black velvet). Antennas of radio collars were marked with a unique color code with rubber coating. No fox appears to have been harmed by capture or handling.

Radiocollars used were provided by Advanced Telemetry Systems (Isanti, MN). Specifications are model 16MC, current drain 0.11-0.13 mA, pulse rate 55 ppm, weight 44 gm, and antenna length 30 cm. The receiving antenna consists of two five element Yagi antennas

combined 180° out of phase (null) mounted through a sunroof in the cab of the research vehicle. The mounting platform is a modification of a design produced by U.S. Geological Survey (M. Sovada, personal communication). Tests of this configuration indicate that under ideal conditions (ie, both transmitter and receiver on hilltops), the signal may be detected at over 2.5 miles. Accuracy and precision tests using radiocollars at known locations (N ' 24) revealed a systematic error of 1.0° and a random error (2 SD) of 1.18°. At one kilometer, with two observations taken at 90° to each other, the 90% error polygon is .0064 km^2 (White and Garrott 1990, p 53), which represents approximately 0.12% of the average home range.

Automatic cameras using active infrared sensors (Trailmaster 1500 with TM 35-1 camera kit and Tm1500 Photo System, Goodson & Associates, Lenexa, KS) at bait stations are being used to locate unmarked foxes. Cameras and receiving censors are placed in boat dry boxes with holes made to permit photographs and the infrared beam. Dry boxes and the infrared transmitting unit are strapped to wooden stakes driven into the ground. The system is set to take bursts of four photographs no less than two minutes apart when the beam is broken for 0.25 sec.

Technology for identifying species and individuals from DNA in scats has been developed for several species, including some canids (Foran et al. 1997, Kohn and Wayne 1997, Maldonado et al. 1997, Paxinos et al. 1997, Kohn et al 1999). These methods allow not only confident identification of the species producing a given scat, but also of the specific individual. Absolute population estimates may be made using scat and mark-recapture or rarefaction techniques (Kohn et al. 1999). To develop this method for swift fox, five genetics laboratories were contacted (Smithsonian Institution, University of California at Los Angeles, University of Wisconsin, University of Montana, and University of New Mexico). Dr. Jerry Dragoo of UNM has developed much of the technology for swift fox and was chosen to conduct DNA analysis of swift fox scat. Marsha Sovada (U.S. Geological Survey, North Dakota) provided scat and blood control samples to Dr. Dragoo from captive swift fox.

Scats are collected both haphazardly when encountered and during systematic searches. Surveys of roadsides by foot and vehicle and inspection of conspicuous objects and locations (fence corners, cattle guards, gates, utility posts, etc.) were compared for productivity. An examination of the potential for using lures to stimulate defecation is being made by comparing scat collection at locations with a fox lure with collection at locations without a lure.

Trial methods to determine presence/absence and relative numbers of swift fox include trapping, searching for tracks, scent stations, spotlighting, and calling.

Searches for tracks have been found useful in other states (Hoagland 1999, Roy et al. 1999). However, no swift fox tracks have been observed on the study area. Track survey methods have included systematic road surveys, examination of conspicuous objects (see above) and marked sites, and examination of ponds and wet ditches. Track surveys will continue when conditions appear favorable, such as after snowfalls. Tentatively, however, soils in the study area, and probably in New Mexico in general, are too hard, dry, and sandy to take and hold

identifiable swift fox tracks. Tracks have been observed only on prepared surfaces, such as scent stations.

Scent stations have been used successfully in New Mexico and other states to survey swift fox (Olson et al. 1999; Sovada and Roy 1996; Harrison and Schmitt 1997). The goal of testing scent stations is to determine what time period of observation and what spacing between stations is best to detect foxes in an area. Observations of marked foxes provide information on the number of stations and nights required to detect all foxes in an area, and are applicable to situations that may have low fox density. Observations of marked and unmarked foxes combined are most applicable to situations with higher fox density. Automatic cameras that take photographs when an object enters the station (described above) are used to determine if foxes visiting the stations are marked or unmarked. Scent stations consist of 76 cm x 76 cm areas cleared of vegetation and covered with a 1:32 mixture of mineral oil and dried plaster sand. Stations are baited with a plaster of paris tablet (Pocatello Supply Depot, U.S.D.A., Pocatello, ID) soaked in a mixture of cod liver oil and mackerel (Trailing Scent, On Target A.D.C., Cortland, IL) and approximately 4 cm^3 of canned mackerel.

Five scent stations with cameras are placed in a transect within the home ranges of radio collared foxes and observed for six nights. Visitation data is subsampled to determine the percentage of transects visited as a function of number of stations per home range (i.e., spacing between stations) and number of nights observed.

Spotlighting has been used in successfully in New Mexico (Harrison and Schmitt 1997) and Kansas (Sovada and Roy 1996) and on kit foxes (Ralls and Eberhardt 1997). Spotlighting on the study area is conducted while driving twice over available roads through known home ranges of swift fox. The area visible by spotlighting comprises a very small portion of a fox's home range and thus this technique is limited by the number of roads available as well as by topography.

Calling has not been previously tested for swift fox, although it has been tested on coyote (*Canis latrans*, Alcorn 1946, Wenger and Cringan 1978, Okoniewski and Chambers 1984). For preliminary tests, tapes of rabbit distress calls and swift fox vocalizations (Cochrane Ecological Institute) were played at various volumes and durations to foxes located by telemetry within 0.5 mile of the observer to determine if foxes will respond.

PRELIMINARY RESULTS AND DISCUSSION.

Twenty-one swift fox have been trapped (9 M, 12 F) in two trapping periods. In winter (Jan. - Mar.), 8 foxes, including one recapture, were captured in 181 trap-nights (4.4%). Trapping success was higher in fall (Aug. - Nov.), resulting in 19 foxes, including 6 recaptures, during 146 trap-nights (13.0%). To replace collars, four foxes were recaptured in enclosure traps at dens (Covell 1992), which resulted in the capture of one new fox. Seventeen remain alive as of this date (9 M, 8 F), but two are missing. For comparison, trapping success in Colorado was

1.2% in June and 9.2% in October (Kahn and Beck 1996).

Scat were easy to find when an accumulation was present. Most scats were found at conspicuous objects and locations. For example, in one four-hour survey, 35 scats were gathered. During a different survey, 25 scats were gathered from one road intersection, which did include a former scent station and a former trapping site. Some den sites also produced numerous scats. Foot surveys for scats along roads within the home ranges of two foxes produced 3 scats from the roadside and 14 from two dens in 3.4 hours of searching. Vehicle surveys of roadsides for 19.5 miles, including the known home range of one fox, produced 2 scats (both within the known home range). Roadside surveys appear to be very inefficient, especially during summer months when vegetation obscures the roadside. Observations at 35 scented and 36 unscented locations did not reveal any enhancement of scat deposition at scented sites after two weeks. Examination of these sites will continue. Dr. Jerry Dragoo (personal communication) estimated the cost of identifying individuals from 250 scat samples to be $6300.

Tests of scent stations have been conducted within the home ranges of three marked foxes to date. A total of ninety station-nights of observation were conducted. Swift fox tracks were first observed on the transects after 1, 3, and 4 nights. On two transects, marked foxes left tracks and were photographed after 3 and 6 nights. On the third transect the marked fox was photographed on the first night, but did not leave tracks. No foxes left tracks without being photographed, although foxes were photographed without leaving tracks. Based upon this limited sample of marked foxes, observation of transects of five scent stations for six nights will result in 66% of foxes being detected. For comparison, Olson et al. (1999) detected foxes in the core portions of their home ranges on 88% of transects after 6 nights.

Unmarked and marked foxes combined made 21 visits to stations (23.3%). By subsampling the data, information was gained about the number of transects that would be visited as a function of the number of nights observed and the number of stations per home range. Detection rate increased smoothly as the number of stations per home range and the number of nights observed increased. Based upon this limited sample, to detect foxes in an area by tracks on scent stations, a spacing between stations of 0.4 miles and an observation period of at least four nights is required to detect foxes on all transects on which they are present. However, a spacing of 0.5 mile and an observation period of four nights will detect foxes on 87% of the transects on which they are present.

Spotlighting was conducted for 117 miles through the known home ranges of at least 15 foxes. No foxes were seen. For comparison, Harrison and Schmitt (1997) spotlighted 9 foxes in 3112 miles (1 fox per 345 miles). Spotlighting is a relatively inefficient technique for statewide surveys (Sovada and Roy 1996, Harrison and Schmitt 1997). However, in certain circumstances, such as immediately after crops are harvested, swift fox may be attracted to specific areas where they may be efficiently spotlighted (S. Bremner, personal communication). In New Mexico, spotlighting is useful primarily as a supplement to other methods, particularly during nighttime periods when other methods can not be pursued. Spotlighting will not be tested further.

Six attempts to call foxes within view using recorded sounds were made. No foxes were observed even though telemetry locations indicated that they should have been able to hear the sounds. In open grassland habitat such as that of the study area, it is impossible to approach foxes by vehicle without being detected. Foxes appear to be wary of vehicles and may have been reluctant to approach. One homeowner was disturbed by the sound. Further trials of calling will be conducted, particularly during the mating season.

If DNA methods prove useful, the most efficient method of determining swift fox presence and relative abundance statewide in New Mexico would be scat collection. Scats may be relatively easily found and do not require any response by foxes. Scent stations are more efficient than trapping, but both do readily detect swift fox. The time involved in setting up scent stations and traps is roughly comparable. Trapping provides positive identification of the species trapped, but scent stations do not present any risk of injury. Spotlighting is very inefficient, but may be useful during nighttime periods when it is not possible to pursue other methods. Calling and track surveys appear to be worthless.

Four marked foxes, all females, have died to date. Two were killed by coyotes , but cause of death could not be determined for the other two. One pup was found dead due to a vehicle strike.

Observations of pups have been limited due to the lack of marked females during rearing season. Observations at two dens revealed two pups each.

Average 95% minimum convex polygon home range size for six foxes with over 30 location points is 5.2 mi^2 (1349 ha, range ' 619 - 2751 ha).

Potential threats to swift fox on the study site include trapping by U.S.D.A. Wildlife Services agents, vehicle strikes, predation by coyotes and other species, and being shot. Wildlife Services activity occurs only in limited areas, and no swift fox have been reported killed. One swift fox pup was killed by a vehicle on state highway NM 39. The home ranges of two adult marked foxes cross NM 39 and they frequently are close to the highway, but they have not been killed. Two natal dens have been observed within a few meters of a secondary road, but no vehicle deaths were observed. No eagles have been observed on the study site, but coyotes are occasionally observed and have been responsible for at least two deaths. Based upon conversations with ranchers, the attitude of local people toward foxes appears to be very positive and there has been no indication that they would shoot foxes for any reason. Hunting does occur in the study area. Hunters may shoot foxes for sport, but the hunting season is limited to a few days per year. No fur trapping or conversion of grassland to cropland has been noted on the study site yet.

Other swift fox research projects in New Mexico in progress or recently completed include a study of ecto- and endoparasites (Patrick, Harrison, Fagerlund, and Schmitt, in preparation), a den site selection study (Kintigh 1999), and a genetic study within the kit fox-

swift fox hybridization zone (Rodrick 1999).

LITERATURE CITED

Alcorn, J. R. 1946. On the decoying of coyotes. J. Mammalogy 27(2):122-126.

Covell, D. F. 1992. Ecology of the swift fox (Vulpes velox) in southeastern Colorado. M.S. Thesis. University of Wisconsin, Madison.

Dick-Peddie, W. A. 1993. New Mexico vegetation, past, present, and future. University of New Mexico Press, Albuquerque, New Mexico, USA.

Foran, D. R., K. R. Crooks, and S. C. Minta. 1997. Species identification from scat: an unambiguous genetic method. Wildlife Society Bulletin 25(4):835-839.

Harrison, R. L., and C. G. Schmitt. 1997. Swift fox investigations in New Mexico, 1997. Pages 97-106 in B. Giddings, ed. Swift fox conservation team annual report. Montana Fish, Wildlife, and Parks. Unpublished report.

Hoagland, J. W. 1999. Swift fox investigations in Oklahoma, 1998. Pages 31-36 in C. C. Roy, ed. 1998 Swift fox conservation team annual report. Kansas Department of Wildlife and Parks. Unpublished report.

Kahn, R., and T. Beck. 1996. Swift fox investigations in Colorado, 1996. Pages 10-15 in B. Luce and F. Lindzey, eds. Annual report of the swift fox conservation team. Wyoming Game and Fish Department. Unpublished report.

Kintigh, K.M. 1999. A den-centered analysis of swift fox habitat characteristics on the Kiowa National Grasslands, New Mexico. Final report. US Forest Service.

Kohn, M. H., and R. K. Wayne. 1997. Facts from feces revisited. Trends in Ecology and Evolution 12(6):223-227.

Kohn, M. H., E. C. York, D. A. Kamradt, G. Haught, R. M. Sauvajot, and R. K. Wayne. 1999. Estimating population size by genotying faeces. Proceedings of the Royal Society of London B 266:657-663.

Kreeger, T. J. 1996. Handbook of Wildlife Chemical Immobilization. International Wildlife Veterinary Services, Laramie, WY.

Maldonado, J. E., M. Cotera, E. Geffen, and R. K. Wayne. 1997. Relationships of the endangered Mexican kit fox (Vulpes macrotis zinseri) to North American arid-land foxes based on mitochondrial DNA sequence data. Southwestern Naturalist 42(4):460-470.

Okoniewski, J. C., and R. E. Chambers. 1984. Coyote vocal response to an electronic siren and human howling. J. Wildlife Management 48(1):217-222.

Olson, T. L., F. G. Lindzey, and J. S. Dieni. 1999. Swift fox detection probability in southeast Wyoming. Pages 51-65 in C. C. Roy, ed. 1998 Swift fox conservation team annual report. Unpublished report.

Paxinos, E., C. McIntosh, K. Ralls, and R. Fleischer. 1997. A noninvasive method for distinguishing among canid species: amplification and enzyme restriction of DNA from dung. Molecular Ecology 6:483-486.

Ralls, K., and L. L. Eberhardt. 1997. Assessment of abundance of San Joaquin kit foxes by spotlight surveys. Journal of Mammalogy 78(1):65-73.

Rodrick, P. J. 1999. Morphological, genetic, and den site characteristics of the kit fox ("Vulpes macrotis") on McGregor Range in south central New Mexico. M.S. Thesis. University of Wisconsin, Madison.

Roy, C. C., M. A. Sovada, and G. A. Sargeant. 1999. An improved method for determining the distribution of swift foxes in Kansas. Pages 4-17 in C. C. Roy, ed. 1998 Swift fox conservation team annual report. Kansas Department of Wildlife and Parks. Unpublished report.

Sovada, M. A., and C. C. Roy. 1996. Summary of swift fox research activities conducted in western Kansas - Annual report. Pages 64-68 in B. Luce and F. Lindzey, eds. Annual report of the swift fox conservation team. Unpublished report.

Wenger, C. R., and A. T. Cringan. 1978. Siren-elicted coyote vocalizations: an evaluation of a census technique. Wildlife Society Bulletin 6(2):73-76.

White, G.C. and R.A. Garrott. 1990. Analysis of Wildlife Radio-Tracking Data. Academic Press, San Diego, CA

TEXAS ANNUAL SUMMARY OF SWIFT FOX

Robert Sullivan, Texas Parks and Wildlife Department, P. O. Box 669, Canyon, TX 79015.

Conservation and Management Activities

I. CURRENT AND FUTURE PLANS FOR MANAGEMENT

A. Current goals of Texas Parks and Wildlife Department (TPW) will be to finish the current research in progress and initiate future research to assess den site ecology of foxes in the Panhandle Region.

B. No additional research, surveys, or management options are currently planned.

C. Future conservation efforts will be dictated by results of our research efforts and current political events. We expect to continue to offer the fox as part of our Land Owner Incentive Program (LIP) and will include management considerations in our ongoing efforts at short- and mid-grass prairie restoration in the Panhandle Region.

II. LANDOWNER INCENTIVE PROGRAM (LIP) – We currently have no landowners that are specifically managing for swift fox on their property and we have received no inquires by landowners for technical guidance to manage swift fox.

III. RESEARCH IN PROGRESS

A. Research Title: Relationships of Swift Fox and Coyotes in Northwest Texas

B. Researcher: Jan F. Kamler, Ph.D. Candidate, Texas Tech University

C. Background and Objectives: *Abstract* – Swift fox (*Vulpes velox*) populations have declined throughout their range and until recently this species was under consideration for listing as a threatened species by the USFWS. Recent studies in CO and KS indicate that the current distribution and number of foxes are significantly affected by coyote (*Canus latrans*) predation. In August 1998, we initiated a study to determine the relationships of swift fox and coyotes in northwest Texas. Research is currently being conducted at two study sites: (1) a 100 sq. km area of range land located on Rita Blanca National Grasslands; and a 100 sq. km area of private land interspersed with rangeland, cultivated and CRP fields. Radio-collared swift fox and coyotes were monitored throughout 1999, and home ranges, densities, habitat use, and survival rates for both species were compared within and between sites. Future research includes continuation of monitoring and initiation of coyote removal from one study site to determine the

affects that coyotes have on the ecology of swift fox in the Panhandle Region of the High Plains.

IV. PROPOSED RESEARCH

A. Research Title: Swift Fox and Coyote Interactions in Short-grass Prairie of Northwest Texas: Dietary Overlap and Den Site Activity.

B. Researcher: Patrick R. Lemons II, Candidate for Master of Science Degree, Texas Tech University.

C. Background and Objectives: *Abstract* – Recently the swift fox (*Vulpes velox*) was proposed for listing under the Federal Endangered Species Act. Once abundant throughout the short-grass and mid-grass prairies of North America, numbers of swift foxes declined rapidly with human settlement. Habitat destruction, trapping, and poisoning are thought to have reduced its numbers. Poisoning campaigns to control wolf (*Canis lupus*) and coyote (*Canis latrans*) are implicated as the primary cause of declines in populations of swift fox; however, coyotes also kill swift fox. This behavior may be the result of both exploitative and interference competition. Another possible explanation for predation of swift foxes by coyotes is competition for resources. The degree of overlap in swift fox and coyote diets is not well documented and dietary overlap may relate to the severity of competition between the two carnivores. Another area that may influence swift fox populations is pup-rearing behavior. Objectives of the study are to determine the : (1) seasonal and yearly dietary differences between swift fox and coyotes; (2) dietary differences in swift foxes on and off coyote controlled territories; (3) what contribution helpers make to pup-rearing; (4) if parental roles change with the presence of a helper in fox societies; (5) if helpers increase success of rearing pups; (6) frequency of helpers on and off coyote controlled sites; (7) proportion of time spent at den sites by each parent; (8) role of each parent in rearing pups (9) if role of each parent changes with the presence of a helper; and (10) pre-emergent and overall pup-rearing success and litter sizes.

SWIFT FOX INVESTIGATIONS IN OKLAHOMA, 1999

Julianne Whitaker Hoagland, Oklahoma Department of Wildlife Conservation, 1801 N. Lincoln Blvd., Oklahoma City, OK 73105; 405-522-0189; FAX 405-521-6535; e-mail jhoagland@odwc.state.ok.us

ABSTRACT

The swift fox (*Vulpes velox*) track search monitoring survey continued in two Oklahoma panhandle counties (Cimarron and Texas) and was initiated in four additional counties (Beaver, Harper, Ellis and Woodward), under a Section 6 project investigating swift fox distribution within the species' historical range. Swift fox were detected in 43 of 114 townships in the six county area. All 43 townships where swift fox tracks were successfully detected occurred in the panhandle region of Cimarron, Texas and Beaver counties.

INTRODUCTION

The swift fox (*Vulpes velox*) is classified as a furbearer species in Oklahoma with a year-round closed season with regard to take. The swift fox is also designated as a state species of special concern in Oklahoma. The swift fox has been documented to occur in the Panhandle region as well as in four counties in the northwestern corner of the main body of the state. Historic range and geographic distribution for the swift fox in Oklahoma is provided in Hoagland (1995) and Hoagland (1996).

During 1998 and 1999, Section 6 funds were available to conduct a swift fox population distribution survey in northwestern Oklahoma, by using a systematic track search survey. The objectives of this project were to: establish a track search survey to monitor population trends of swift foxes throughout the shortgrass High Plains ecoregion in Oklahoma; and develop a baseline database of swift fox distribution and abundance in northwestern Oklahoma. The track survey also allowed the populations of all terrestrial furbearer species to be monitored in the region. Data collection was initiated in August 1998 and is scheduled to be completed in September 2000. The project is being conducted by the Oklahoma Department of Wildlife Conservation (ODWC).

METHODS

Six ODWC personnel, four county game wardens and two wildlife biologists, conducted the track search surveys. All ODWC personnel were knowledgeable in reading furbearer tracks and with the area and local wildlife to be surveyed. The study area was defined as the shortgrass High Plains ecoregion that occurred within the historical swift fox range in Cimarron, Texas, Beaver, Harper, Ellis and Woodward counties. Every other township in the identified study area

was surveyed for furbearer tracks. Survey sites within each township were carefully selected, based on areas with the highest probability of finding swift fox tracks if swift foxes were present. Thus, survey locations focused on areas with herbaceous range habitat, flat terrain, the best available substrate for tracks, little vehicle traffic, and a lack of human disturbance. The same tracking sites were used each year unless major changes occurred that required new sites to be selected.

All track surveys were conducted during the months of August and September, during 1998 and 1999. Fifty-seven townships were identified to be surveyed for swift fox tracks during 1998 while 114 townships were targeted for track searches during 1999. Track searches were conducted with a minimum search time per township of 30 minutes and a maximum of 2 hours. Once a swift fox track was found, the time of search was recorded. The tracker continued searching if the track was found during the first 30 minutes of the search period, or moved on to the next township, after the initial 30 minutes. Since survey success was affected by time of day and weather conditions, track searches were conducted when possible during morning hours and 24 hours following a rainfall event, when possible.

For the purpose of selecting track search locations, broad habitat categories were delineated within the study area by using ArcView GIS 3.0, based on United States Geological Survey (USGS) land use and land cover data at 1:250,000 (USGS 1990). Classification codes used in data analysis included urban/industrial, cropland, including Conservation Reserve Program grasses (CRP), herbaceous rangeland, shrub rangeland, mixed rangeland, deciduous forest, evergreen forest, and water/wetlands. Habitat categories were ground verified for the townships surveyed. The habitat type recorded where swift fox and other furbearer tracks were located was recorded as range, CRP, fallow, winter wheat, irrigated crop (e.g. corn), other crop (e.g. milo, soybeans), and juniper mesa.

RESULTS

During 1999, all 114 townships in the targeted study area were successfully searched for swift fox tracks. The total cost for surveying the 19,349.05 km^2 area was $9,802.34, which averaged $86.00 per township. Trackers drove an average of 37 miles per township and averaged 8 days to complete the surveys. Swift fox tracks were detected in 43 (37.7%) of the townships surveyed (Figure 1). For each township where swift foxes were successfully detected, it took an average of 46 minutes to detect the first track; range 0 to 103 minutes. Swift fox tracks were detected within the first 30 minutes in 14 of the 43 townships. In 32 townships, swift fox tracks were found within the first hour. Eleven townships found swift fox tracks during the second hour of tracking. Forty townships had only one set of swift fox tracks observed during the initial 30 minutes; three townships had two sets of swift fox tracks detected within the initial 30 minute search interval.

In Cimarron and Texas counties, where data were available for both 1998 and 1999, the number of townships where swift fox tracks were detected declined 31.4%, from 35 townships to

24 townships (Table 1). The average time it took to detect swift fox tracks, if they were found, increased from 39 to 46 minutes, and the number of townships where swift fox tracks were observed within the first 30 minutes declined 70.6%, from 17 townships in 1998 to five townships in 1999 (Table 1). Swift fox tracks were not found more than one time within the first 30 minutes in any township during 1999, compared to seven townships where more than one set of swift fox tracks was observed in 1998 (Table 1).

During 1998, 42% of sites where swift fox tracks were observed in Cimarron and Texas counties had soil tracking conditions that were considered good to excellent, while in 1999, this percentage dropped to 34% (Table 2). The percentage of surveys conducted within one to three days following a rainfall event also dropped from 74% in 1998 to 51% in 1999, while the percentage of surveys conducted more than three days following a rainfall increased from 21% to 42% between 1998 and 1999 (Table 2). Likewise, the percentage of track search surveys conducted while winds were between one and five miles per hour decreased between years, from 68% to 44%, while the percentage of surveys conducted when wind speeds were greater than five miles per hour increased from 32% to 56% between 1998 and 1999 in the two county area (Table 2).

Table 1. Comparison of swift fox track detection statistics in Cimarron and Texas counties between 1998 and 1999.

Swift Fox Tracking Variables Recorded	1998	1999
Townships surveyed	57	57
Townships with swift fox tracks	35	24
Average time to first track in minutes	39	46
Townships with tracks observed within first 30 minutes	17	5
Townships with >1set of swift fox tracks observed	7	0

Table 2. Soil tracking conditions, days since last rain, and wind conditions recorded during swift fox surveys in Cimarron and Texas counties during 1998 and 1999.

Environmental Conditions	1998	1999
Percentage of swift fox track sites with good to excellent tracking conditions	42%	34%
Percentage of surveys conducted within 1 to 3 days following a rain event	74%	51%
Percentage of surveys conducted greater than 3 days following a rain even.	21%	42%
Percentage of surveys conducted with winds 1 to 5 mph	68%	44%
Percentage of surveys conducted with winds > 5 mph	32%	56%

During 1999, swift fox tracks were detected on two-track and dirt roads in rangeland habitats 68% of the time, compared to 9% alongside or within fallow crop fields, 9% alongside or within winter wheat fields, 7% alongside CRP, 5% alongside or within other crop fields, and 2% alongside or within irrigated crop fields (Figure 2). Habitats searched in townships where swift fox tracks were not observed included 46% rangeland, 19% CRP, 13% fallow, 8% other crop, 7% winter wheat, 5% irrigated crop, and 1% juniper mesa. Cropland, including CRP lands, composed 51.2% of the entire study area. Rangeland comprised 49.1% of the study area, with 83.5% of the rangeland existing as herbaceous rangeland, 0.0002% as shrub rangeland, and 16.4% as mixed rangeland. In the panhandle region, cropland comprised 49.9% of the area and rangeland 48.4%; with the rangeland existing as 92.2% herbaceous range, 0.0003% shrub range, and 7.7% mixed rangeland. The rangeland plant community consisted primarily of blue grama (*Bouteloua gracilis*)-buffalograss (*Buchloe dactyloides*), interspersed with sandsage (*Artemesia filifolia*). The mixed rangeland also consisted predominately of blue grama and buffalograss, along with sandsage, yucca (*Yucca glauca*), and cholla cactus (*Opuntia imbricaria*). In the extreme eastern edge of the study area, eastern redcedar (*Juniperus virginiana*) encroachment was evident in the mixed range land use category.

Other furbearers detected with the survey during 1999 included, coyote (*Canis latrans*) in 99 townships (86.8%), badger (*Taxidea taxus*) in 42 townships (36.8%); raccoon (*Procyon lotor*) in 39 townships (34.2%), striped skunk (*Mephitis mephitis*) in 39 (34.2%) townships, bobcat (*Lynx rufus*) in 21 (18.4%) townships, domestic dog (*C. familiaris*) in 18 (15.8%) townships, and domestic cat (*Felis catus*) in 6 (5.3%) townships. Tracks of black-tailed jackrabbits (*Lepus californicus*) and eastern cottontail rabbits (*Sylvilagus floridanus*) were observed at 50 and 42 townships, respectively, and prairie dogs (*Cynomys ludovicianus*) were seen in 10 townships while surveying tracks. Information concerning jackrabbits, cottontails and prairie dogs, however, was only noted casually, and not specifically requested.

DISCUSSION

Results from track search surveys conducted for swift fox in Oklahoma indicate that this method has been an effective technique for conducting landscape-scale presence/absence surveys for swift fox. Because track searches were restricted to habitat believed most suitable for swift fox and most favorable for finding tracks, costs were controlled and high detection rates were achieved. Data quality was enhanced by using experienced ODWC employees as trackers. The use of county game wardens to conduct the survey aided tremendously in the ability to access private rangeland throughout the study area.

Swift fox tracks were encountered more often in herbaceous rangeland habitats than any other habitat type, however, herbaceous rangeland habitat was the habitat type searched whenever it was available within a survey township. Swift fox tracks were observed in agricultural areas throughout the study area, but agricultural areas were not searched in proportion to their availability. If cropland and rangeland were both present in a township, only

the rangeland was most likely surveyed. The proportion of rangeland existing as herbaceous rangeland in Panhandle was 92.2% while shrub and mixed range comprised 7.7%. Outside the Panhandle, the percentage of the existing rangeland that occurred as herbaceous range dropped to 57.0%, while the mixed herbaceous/shrub range increased to 42.9%. Because of the increasing vegetation density and height in the mixed herbaceous/shrub range, this habitat is not considered suitable for swift fox when compared to the relatively shorter, herbaceous rangeland vegetation that occurs in the shortgrass High Plains ecoregion.

In general, the terrain in the Panhandle portion of the study area was flatter than that of the main body of the state (Figure 3). From west to east across the study area, a greater proportion of the available herbaceous range occurred in rugged terrain where land conversion to cropland was not convenient. On the flatter terrain in the Panhandle portion of the study area, winter wheat was the predominant land use, while in the main body of the state, a greater proportion of the flatter terrain occurred as mixed range rather than as winter wheat. Thus, the amount of optimal swift fox habitat decreases from west to east through the shortgrass High Plains ecoregion within in Oklahoma.

Swift fox tracks were not observed using this survey outside the Panhandle region during 1999. Tracks were observed in one township in Harper County, but the two-hour time limit for the track search survey had already elapsed. A road kill swift fox was also recorded from Ellis County during the spring of 1999, prior to the when track search survey was conducted. Although this information indicates the presence of swift fox in the main body of the state, the extent to which the species occurs in the far eastern reaches of the shortgrass High Plains ecoregion is unknown.

The swift fox track detection rate decreased between 1998 and 1999 in the two counties for which data were available for both years (Cimarron and Texas counties). During the 1998 tracking season, this region received above normal rainfall, allowing 74% of the tracking surveys to be conducted within three days following a rainfall event. In contrast, only 51% of the track search surveys conducted during 1999 were done within three days after a rainfall. Conducting track searches following rainfall events resulted in better tracking conditions and may have resulted in more swift fox tracks being observed within these counties during 1998 than in 1999. The tracking substrate in Texas County, was particularly affected by precipitation patterns during the two years surveyed, and track detection rates dropped from 57% in 1998 to 37% in 1999.

LITERATURE CITED

Hoagland, J. W. 1995. Distribution and ecology of swift fox in Oklahoma. Pages 33-38 *in* Allen, S. H. et al. (eds.) Report of the Swift Fox Conservation Team. 170 pp.

Hoagland, J. W. 1996. Oklahoma swift fox status report - 1996. Pages 30-49 *in* Luce, B. and F. Lindzey (eds.) Annual Report of the Swift Fox Conservation Team. 110 pp.

USGS 1990. Land Use and Land cover digital data from 1:250,000 and 1:100,000 scale maps. National Mapping program, Technical Instructions Data Users Guide 4.

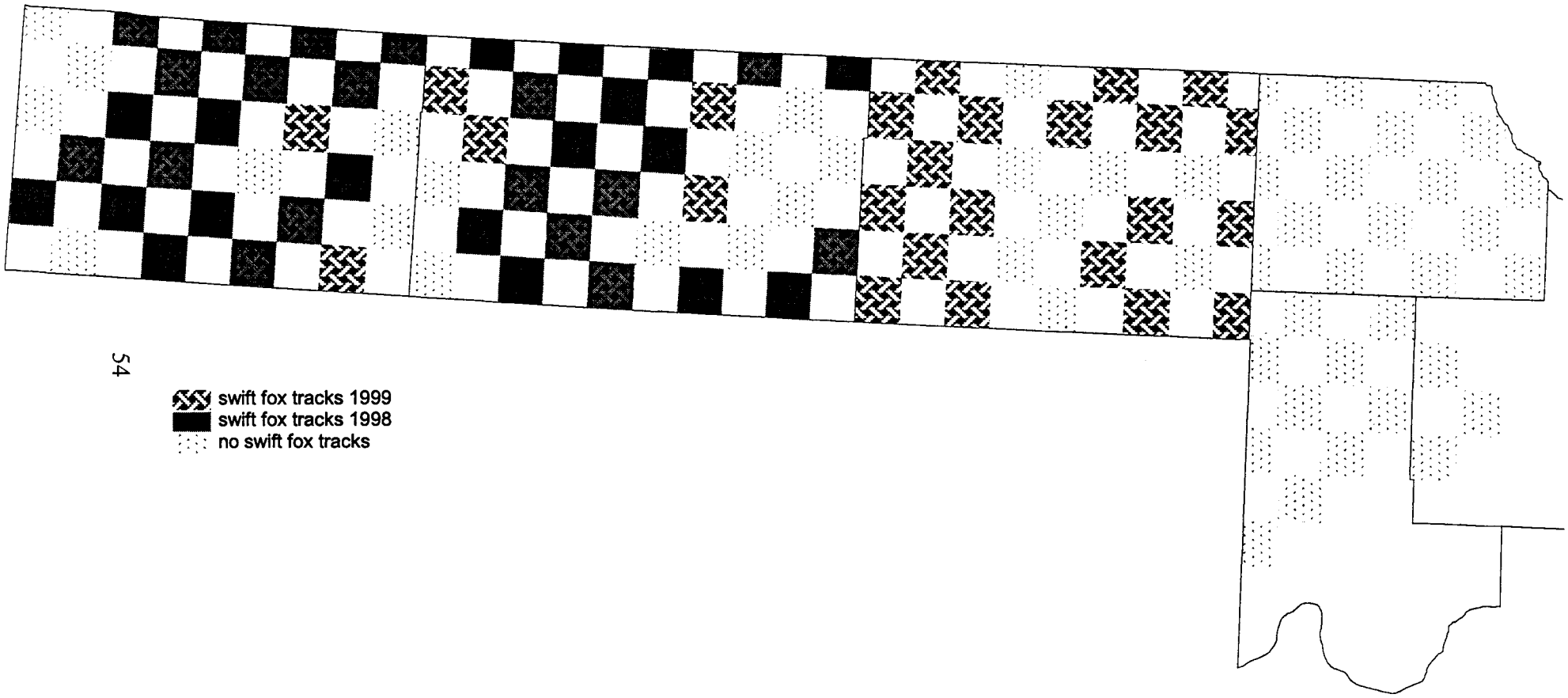


Figure 1. Townships where swift fox tracks were detected in Oklahoma, 1998 and 1999 (only Cimarron and Texas counties were surveyed in 1998).

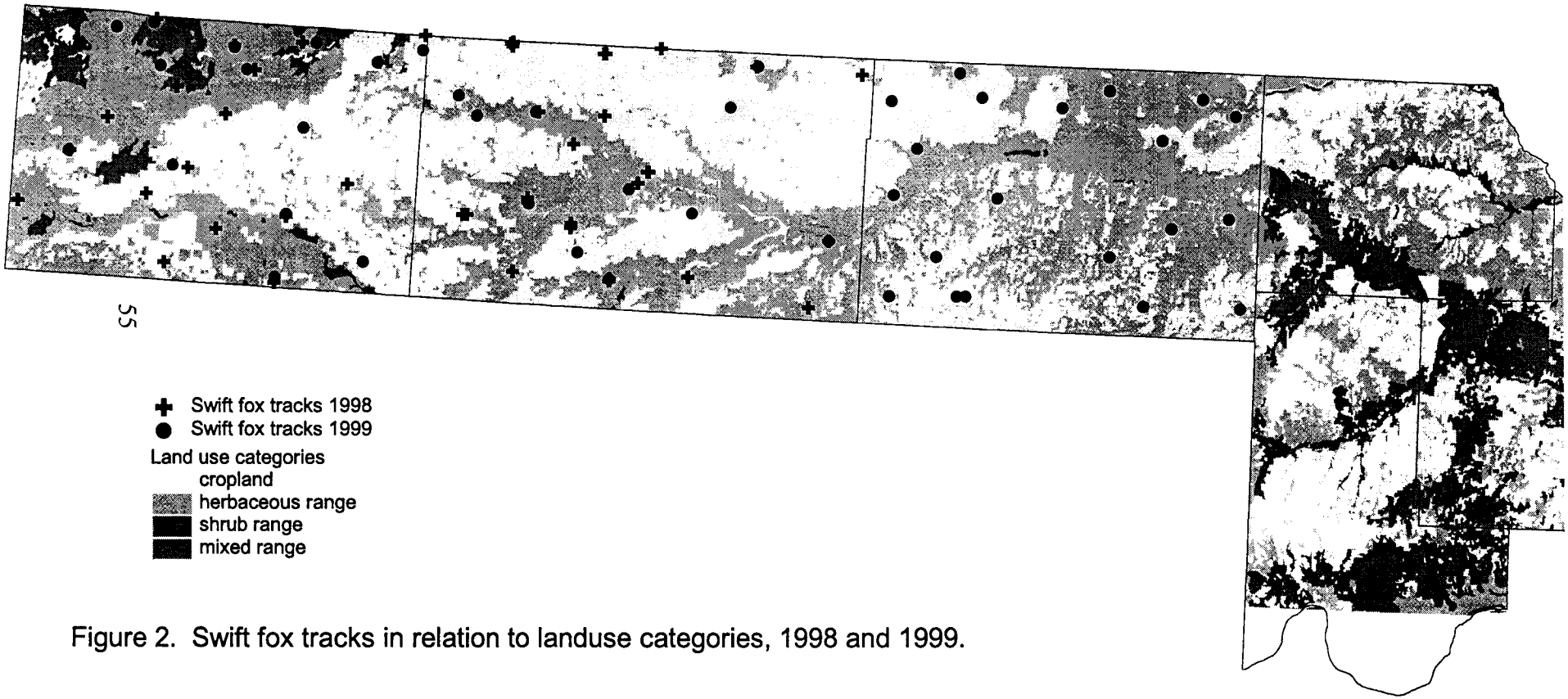


Figure 2. Swift fox tracks in relation to landuse categories, 1998 and 1999.

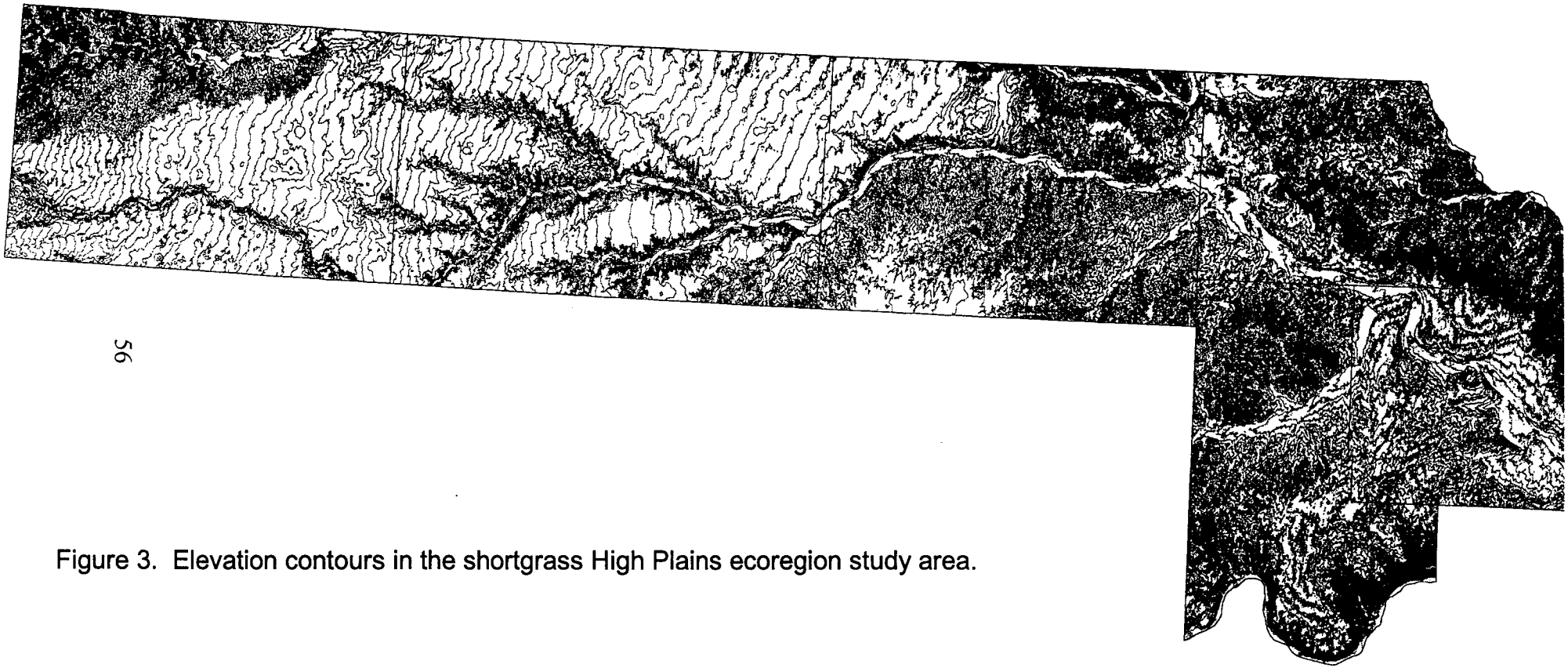


Figure 3. Elevation contours in the shortgrass High Plains ecoregion study area.

SWIFT FOX CONSERVATION TEAM ACTION ITEMS FOR 1999 (KANSAS)

Christiane Roy, Kansas Dept. of Wildlife and Parks,1830 Merchant Box 1525, Emporia, KS 66801-1525, (316) 342-0658 #202, (316) 342-6248 fax, christir@wp.state.ks.us

3.1.1 Kansas completed it's third and final year of the track survey (details provided in past annual reports). The survey has proven to be a reliable means of determining the presence of swift fox in areas where:

1) roads are abundant
2) tracking conditions are good (lots of substrate to see tracks)
3) weather conditions are good.

We had poor luck finding tracks last year due to poor dry and windy conditions making track id very difficult and questionable. This method is much harder to apply to large expenses of grasslands where sand and oil stations may be more appropriate and reliable indicator of presence or absence. We still however added 9 NEW townships to our list of current locations.

3.1.2 same as above. The tracking method currently used will provide information on changes in the distribution of swift fox populations (annual or periodic trends).

3.1.3 pelt tagging has been in place in Kansas since 1994. Due to poor pelt prices, few swift foxes are tagged. Most foxes (~90%) are taken incidentally to coyote trapping (see annual reports), and are discarded in the field due to the difficulties and time required to acquire pelt tags. Hence tagging is not financially worth the effort to the furharvester and valuable information is lost due to the current tagging procedures. Potential changes would be to require furdealers to tag pelts and turn in data sheets to the state in addition to their annual fur transaction record books as opposed to restricting pelt tagging to KDWP employees. I will be proposing this change this coming year.

5.1.1. Swift foxes in Kansas are unique in that they occupy both rangeland and cropland (wheat stubble, winter wheat, corn, sunflower, plowed fields, etc) habitats throughout the short grass prairies. Annual reports for the past three years have provided information on the proportion and types of habitats associated with the presence of swift fox throughout the surveyed areas.

5.1.2. Gap analysis projects are near completion and will provide detailed habitat survey information. Expect final product is expected for 2000.

5.1.3. will be addressed as soon as 5.1.2 is completed. hopefully before Dec. 2000. The data acquired in Kansas throughout years of research has indicated that habitat is less important then previously believed in limiting swift fox distribution. Although short vegetation is important, and substrate where dens can be easily dug, food, predation, certain human disturbances (roads) are more likely to limit swift fox distribution and potential colonization.

8.1.1. KDWP has provided data to universities involved in the GAP projects and has continued distributing information on survey results to other universities and federal agencies.

9.1.3 Important improvements in CRP programs have taken place in the past 2 years , where planted grasses for CRP lands favor more natural species typical of short grass prairie ecosystems. This effort was pioneered by both state and federal agencies to benefit short grass prairie ecosystems. However, substantial still needs to be addressed since a landowner can still plant tall grass prairie to benefit e.g . pheasants, as opposed to native short grass prairie species.

SURVEY OF FURBEARERS IN FALL RIVER COUNTY SOUTH DAKOTA WITH EMPHASIS ON SWIFT FOX (*VULPES VELOX*)

Richard A. Peterson, Jonathan A. Jenks, Department of Wildlife and Fisheries Sciences, South Dakota State University, Brookings, SD 57007-1696, and Eileen Dowd Stukel, [2]South Dakota Department of Game, Fish and Parks, 523 East Capitol, Pierre, South Dakota 57501

ABSTRACT

Suitable soil substrates in 2 survey areas of Fall River County, South Dakota containing both public (i.e., Buffalo Gap National Grassland) and private rangeland were searched for evidence of furbearers with emphasis on swift fox (*Vulpes velox*) between 1 September and 4 November 1999. Surveys of roads, dams, creeks, and cowpaths were conducted by walking selected land quarter sections (64.8 ha [160 acres]) and documenting sign (i.e., tracks, feces) of furbearers. A total of 430 quarter sections were searched. Identifiable evidence of furbearers was found in 253 quarter sections. Sixty-three percent of the evidence was found on the shores of stock dams. Striped skunks (*Mephitis mephitis*), coyotes (*Canis latrans*), and raccoon (*Procyon lotor*) were the most abundant furbearers. Evidence (tracks, den sites) of swift fox presence was found in 17 quarter sections in Survey Area 1 and at one potential location in Survey Area 2. Sixteen (94%) of the swift fox tracks/sign in Survey Area 1 occurred in quarter sections with no red fox (*Vulpes vulpes*) sign. Fifty-three percent of quarter sections with swift fox sign did not contain coyote sign. Eighty-five percent of quarter sections in Survey Area 2 contained coyote sign.

INTRODUCTION

Historically the swift fox ranged over much of the Great Plains. Although currently abundant in some portions of its range (e.g., Colorado, Kansas, and Wyoming), it is listed as a state threatened species in South Dakota (South Dakota Wildlife Diversity Homepage, http://www.state.sd.us/gfp/diversity/index.htm). Swift fox presence has recently been documented in Fall River (Kruse et al. 1995) and Shannon (Kruse et al. 1995, Dateo et al. 1996) counties in South Dakota. The purpose of this study was to determine relative abundance of furbearers and the general distribution of the swift fox population in Fall River County in 1999 using quarter-section track surveys of suitable soil substrates in areas of the county previously occupied by swift fox.

SURVEY AREAS

Surveys were conducted within 2 areas in Fall River County, South Dakota. Survey Area 1 was approximately 257 km^2 (100 mi^2 [397 quarter sections]) of south central Fall River County northeast of Ardmore, South Dakota. This survey area, consisting of both public and private rangeland, was selected because a swift fox population has been known to occur in the past and because recent results of bait station transects on the Buffalo Gap National Grassland indicated a decline in the population (L. Hetlet, USDA Forest Service, Hot Springs, SD, pers. commun.).

The final size of this area was determined by access to private land; 67% of landowners allowed access to their properties. Survey Area 2 consisted of 21 km^2 (8 mi^2 [33 quarter sections]) of the Buffalo Gap National Grassland northeast of Smithwick, South Dakota. It was selected because swift fox were previously documented at the site (Hetlet 1995).

Landscape features of both study areas consisted primarily of undulating to rolling topography with low to moderate slopes. Survey Area 1 had only a small area of shale outcrop and steep breaks on the north but Survey Area 2 had several areas of steeper topography along 3 canyons that bisected the area. All soils are derived from dark shales with scattered rock beds on ridgetops. High runoff from the rather impervious heavy clay, gumbo, soils has created steep sided gullies in many drainages. Some gullies in Survey Area 2 are extensive enough to be called canyons (i.e., Hay, Jim Wilson, and First Black canyons). Creeks are often dry except for intermittent pools. Primary creeks in Survey Area 1 are North and South Black Banks creeks and Medicine Creek all draining east to Horsehead Creek and Long Hollow Creek running west to Hat Creek. Many small earthen dams provide stock water and greatly diversify the wildlife habitat available in the area. Vegetation of most uplands is dominated by western wheatgrass (*Agropyron smithii*), green needlegrass *(Stipa viridula)*, little bluestem (*Andropogon scoparius*), blue grama (*Bouteloua gracilis*), buffalo grass (*Buchloe dactyloides*), and various exotics, such as Japanese brome (*Bromus japonicus*) and sweet clover (*Melilotus officinalis*). In drainages, inland saltgrass (*Distichlis spicata*) and alkali sacaton (*Sporobolus airoides*) were common. Croplands are an insignificant portion of the surveyed area. Trees and shrubs are completely absent from all but the extreme western and northern portions of Survey Area 1, where some silver sagebrush (*Artemisia cana*) can be found, along with plum (*Prunus americana*), green ash (*Fraxinus pennsylvanica*) and cottonwood (*Populus deltoides*) trees in drainages. In Survey Area 2, woody plants, like snowberry (*Symphoricarpos occidentalis*) and a few cottonwoods occur only in portions of Hay, Jim Wilson, and First Black canyons. Scattered areas of yucca (*Yucca glauca*) and broom snakeweed (*Gutierrezia sarothrae*) occur on the uplands of both survey areas. Only one black-tailed prairie dog (*Cynomys ludovicianus*) town was found in Survey Area 1. The northern portion of Survey Area 2 contains several large black-tailed prairie dog towns.

Especially on public but also on much of the private rangeland, the height and density of the residual vegetation cover in fall 1999 was unprecedented (based on conversations with ranchers and Forest Service personnel). In recent years and in 1999 the area had precipitation much above normal with stock dams full to overflowing and many springs flowing all summer and into the fall. However, even with this above normal precipitation, Survey Area 1 was characterized (based on general observations) by low residual cover on private and state school lands in the northern portions of the area, possibly due to past grazing history. Survey Area 2 had qualitatively more moderate to high residual cover than Survey Area 1, with low residual cover restricted to prairie dog towns. The only significant precipitation during the survey period occurred at the beginning of the study, which restricted suitable substrates in many quarter sections to stock dams and pools remaining in creeks.

METHODS

Track/sign searches (Allen 1996) were conducted from 1 September to 4 November 1999. Features with predictable tracking surfaces (e.g., stock dams and drainages) were searched within each quarter section and other features (e.g., 2-track roads and cowpaths) were searched opportunistically to determine relative occurrence of furbearers. Sign on uplands (e.g., dens and other diggings and feces) was recorded as it was encountered if the evidence could be identified to species. Searches were conducted in both mornings and afternoons. Species sign in each quarter section and the type of feature where found were recorded. Canid tracks were measured and categorized by length according to S. Allen (North Dakota Game and Fish Department; unpubl. data, 1996) and Olson et al. (1997). Canid tracks 39 mm or less in length were identified as swift fox and tracks 40 - 42(mm) were placed in a swift fox/red fox (*Vulpes vulpes*) overlap category. When 2 or more tracks of an individual were present (i.e., front and hind paw prints), a range of size for each set of canid tracks was recorded. The average length of juvenile tracks was considered the low side of the range for the species. For swift fox, tracks of 32-36(mm) were considered juveniles. Unfortunately no width measurements of canid tracks were documented.

RESULTS AND DISCUSSION

Survey Area 1

A total of 397 quarter sections were searched (Table 1). Sign was found on uplands in 33 (19%) of these quarter sections; 173 (43%) of quarter sections contained no suitable track surfaces. No evidence of furbearers was found in 21 quarter sections where all suitable track surfaces were likely trampled by domestic cattle. In 235 quarter sections where recent evidence of furbearers was found, a total of 531 individuals was recorded; 139 skunk, 127 coyote, 101 raccoon, 53 muskrat (*Ondatra zibethicus*), 35 white-tailed jackrabbit (*Lepus townsendii*), 26 badger (*Taxidea taxus*), 19 red fox, 16 swift fox, 8 cottontail rabbit (*Sylvilagus* spp.), 4 mink (*Mustela vison*), 2 dog (*Canis familiaris*), and 1 swift/red fox. Recent evidence included tracks and other sign identifiable with reasonable certainty, such as feces of coyote, jackrabbits, and cottontail rabbits (*Sylvilagus floridanus*), and badger and skunk diggings (pits). Other evidence included 2 swift fox dens. These dens conformed to the normal swift fox den site (i.e., near hill top, several openings of about 20 cm diameter, flattened dirt fan), although both were well revegetated. One was occupied by Burrowing Owls (*Athene cunicularia*); the other had one hole recently cleaned out with a swift fox track at the edge in freshly dug dirt. Locations of 3 natal dens that had been active 4 or 5 years previous to this study (based on reports by landowners) and 3 dens reported by Hetlet (1995, 1996, 1998) on Buffalo Gap National Grassland also were visited. Evidence (furbearer sign) recorded by habitat feature included: 309 at dams, 109 along creeks, 33 from hardpan or overflow areas, 32 from upland range sites, 24 from cowpaths, 20 from 2-track roads, 3 from prairie dog towns, and 1 from cropland (14 total from dams in cropland).

Swift fox tracks and/or sign was found in 17 quarter sections in Study Area 1: 9 adults (35-

39mm), 7 juveniles (32-36mm), one den site (Fig. 1). Three of the quarter sections with swift fox tracks contained 2 sets of tracks (duplicate sets of tracks were not included in analyses). Sixteen (94%) of the swift fox tracks/sign occurred in quarter sections with no red fox tracks. Eight (47%) quarter sections with swift fox sign also contained coyote sign. Twelve (10%) of 122 quarter sections with coyote sign also contained red fox sign. The swift/red fox overlap track was a single 40-mm print in soft mud; other canid tracks at this location were coyote. No swift fox sign in Survey Area 1 was closer than 3.2 km to a prairie dog town. Seven swift fox tracks found at stock dams were oriented perpendicular to shore (only at one dam did they parallel the shore). Other canid tracks (e.g., coyote) also were found along the water and were oriented both parallel and perpendicular to the shore. Of the 7 swift fox tracks along creeks, 6 were oriented perpendicular to the creek border; only one traveled a short distance parallel to the border. Two swift fox tracks were found on cowpaths. The most interesting set of tracks came down to a shallow pool in North Black Banks Creek, which contained many large bullheads (*Ameiurus* spp.). This was the smallest set of tracks (32 - 34mm) found. Cover type of all quarter sections with swift fox tracks was native rangeland. Most swift fox tracks (81%) were found in quarter sections with short to mid-height grasses. In addition, most tracks (69%) were found in areas with low to moderate slopes.

Survey Area 2

Survey Area 2 was not searched as intensively as Survey Area 1; a total of 33 selected quarter sections were searched (Table 1). Three locations yielded no sign. Of the 30 quarter sections with furbearer evidence, 83 individuals were recorded including 28 coyotes, 12 raccoons, 15 muskrats, 7 skunks, 3 jackrabbits, 3 red foxes, 2 cottontail rabbits, 1 badger, 1 potential swift fox, and 11 dogs.

There were fewer suitable substrates in Survey Area 2, especially along creeks, which were often overgrown with tall vegetation. As well, many of the dams in this area were apparently visited by duck hunters and held tracks of dogs. Sections without dams, or that seemed to have mostly moderate to high residual cover or steep slopes were not searched. There was a higher percentage of locations with coyote tracks in Study Area 2 (85 vs. 32%) and fewer skunk (18 vs. 35%) than in Survey Area 1 (Table 1). Much search time was spent in prairie dog towns, but no swift fox sign was noted, except for the one set of possible prints at the stock dam within a large prairie dog town. The potential swift fox prints measured 38 and 40 mm in length. These were the only canid tracks of this size found in the area. Cover type was native rangeland. The residual cover in the quarter section with potential swift fox sign was low and topography was low to moderate, which was similar to quarter sections containing swift fox sign in Survey Area 1.

ACKNOWLEDGMENTS

We gratefully acknowledge the help and cooperation of landowners in Fall River County and Fall River Ranger District personnel R. Hodorff, and especially L. Hetlet for information of swift

fox occurrence on the Buffalo Gap National Grassland and for advice on identifying swift fox tracks, feces and dens. G. A. Wolbrink and V. J. Smith assisted with data analyses. This study was funded by the South Dakota Department of Game, Fish and Parks from Section 6 funds administered through the United States Fish and Wildlife Service.

LITERATURE CITED

Allen, S. H. 1996. Investigation of furbearer occurrence with special reference to swift fox and preliminary modeling of possible swift fox population dynamics in North Dakota. Pages 18-24 *in* B. Luce and F. Lindzey (eds.) Annual report of the swift fox conservation team, 1996. Wyoming Game and Fish Department, Lander, Wyoming. 110pp.

Dateo, D. M., J. A. Jenks, E. Dowd Stukel, and C. S. DePerno. 1996. Survey of swift fox (*Vulpes velox*) on Pine Ridge Oglala Sioux Indian Reservation, Shannon County, South Dakota. Pages 69-75 *in* B. Luce and F. Lindzey (eds.) Annual report of the swift fox conservation team, 1996. Wyoming Game and Fish Department, Lander, Wyoming. 110pp.

Hetlet, L. A. 1995. 1995 Swift Fox Survey - Fall River Ranger District - Buffalo Gap National Grassland, Nebraska National Forest. Pages 139-150 *in* S. H. Allen, J. W. Hoagland, and E. Dowd Stukel (eds.) Report of the swift fox conservation team, 1995. North Dakota Game and Fish Department, Bismarck, ND. 166pp.

Hetlet, L. A. 1996. 1996 Swift Fox Survey - Fall River Ranger District - Buffalo Gap National Grassland, Nebraska National Forest, Hot Springs, South Dakota Pages 76-85 *in* B. Luce and F. Lindzey (eds.) Annual report of the swift fox conservation team, 1996. Wyoming Game and Fish Department, Lander, Wyoming. 110pp.

Hetlet, L. A. 1998. 1998 Swift Fox Survey - Fall River Ranger District - Buffalo Gap National Grassland, Nebraska National Forest, Hot Springs, South Dakota. Pages 79-84 *in* C. C. Roy (ed.) 1998 swift fox conservation team annual report. Kansas Department of Wildlife and Parks, Emporia, Kansas. 107 pp.

Kruse, K. W., J. A. Jenks, and E. Dowd Stukel. 1995. Presence of swift fox (*Vulpes velox*) in southwestern South Dakota. Pages 91-99 *in* S. H. Allen, J. W. Hoagland, and E. Dowd Stukel (eds.) Report of the swift fox conservation team, 1995. North Dakota Game and Fish Department, Bismarck, ND. 166pp.

Luce, B. and F. Lindzey, eds. 1996. Annual report of the swift fox conservation team, 1996. Wyoming Game and Fish Department, Lander, Wyoming. 110pp.

Olson, T.L., J.S. Dieni, and F.G. Lindzey. 1997. Swift fox survey evaluation, productivity, and survivorship in southeast Wyoming. Pages 57-76 *in* B. Giddings (ed.) Swift fox conservation team annual report. Montana Department of Fish, Wildlife, and Parks, Helena, MT. 125 pp.

Table 1. Species sign (tracks, feces, dens) observed in surveys of quarter sections in two survey areas in Fall River County, South Dakota.

	Survey Area 1		Survey Area 2	
Species	Quarter Sections[1]	Percent	Quarter Sections	Percent
Skunk (*Mephitis mephitis*)	138	34.8	6	18.2
Coyote (*Canis latrans*)	126	31.7	28	84.8
Raccoon (*Procyon lotor*)	99	24.9	12	36.4
Muskrat (*Ondatra zibethicus*)	52	13.1	15	45.4
White-tailed Jackrabbit (*Lepus townsendii*)	35	8.8	3	9.1
Badger (*Taxidea taxus*)	26	6.5	1	3.0
Red fox (*Vulpes vulpes*)	19	4.8	3	9.1
Swift fox (*Vulpes velox*)	17	4.3	0	0.0
Rabbit (*Sylvilagus* spp.)	8	2.0	2	6.1
Mink (*Mustela vison*)	4	1.0	0	0.0
Dog (*Canis familiaris*)	2	0.5	11	33.3
Swift fox/red fox overlap	1	0.3	1	3.0
No sign/unknown	174	43.8	3	9.1

[1]Number of quarter sections surveyed was 397 and 33 for Survey Areas 1 and 2, respectively.

INVESTIGATION OF FURBEARER OCCURRENCE IN NORTH DAKOTA WITH SPECIAL REFERENCE TO SWIFT FOX, 1999

Stephen H. Allen, North Dakota Game and Fish Department, 100 N. Bismarck Expressway, Bismarck, ND 58501. (701-328-6300; fax 701-328-6352; e-mail. sallen@state.nd.us)

ABSTRACT

Sections were selected randomly and optimal quarter-sections within those sections were selected on site for survey (n=40). Furbearer occurrence was determined by identifying tracks to species. Presence of red fox, coyote, striped skunk, and raccoon were determined. No swift fox were detected. Differential reporting rates for red fox and coyote harvests and confirmed swift fox observations indicate swift fox exist at extremely low densities if at all in North Dakota. An additional 15 quarter sections and 18 adjacent non-paved public thoroughfares were selected and examined for furbearer occurrence by species. No difference in occurrence ($P > 0.05$) of occurrence by species was detected in quarter-sections compared to roadsides. A major epizootic of sarcoptic mange is dramatically affecting canid densities and distribution in North Dakota wspecially in the eastern and northern portions of the state.

INTRODUCTION

Interest in swift fox (Vulpes velox) has increased greatly in recent years. Swift fox were common in North Dakota during pre-settlement times (Bailey 1926, Thwaites 1953); however, the species became very rare about 1880-1900 (Bailey 1926). Swift fox are known to be very rare in North Dakota; however, data are being collected annually with which to make inference concerning the occurrence of the species. Initially southwestern North Dakota has been selected for study, because of occasional reports of possible swift fox in these areas. . The objective of this report is to present the results of a survey to determine relative occurrence of all furbearer species in this area with special reference to swift fox .

STUDY AREA AND METHODS

Surveys were conducted in southwestern North Dakota in 1999. This area is primarily semi-arid prairie grassland with some intermixed cropland and hayland. Topography is generally rolling grassland to rough broken badlands; native hardwoods trees and shrubs occur in the many of the deeper coulees. Climate in North Dakota is typical of sub-arctic continental interiors with hot summers and cold winters.

Track surveys were conducted to determine relative occurrence of furbearers in each quarter section surveyed. The survey was modified from one developed by Sargeant et al. (1993). Timing of the survey minimizes errors in correctly identifying species caused by

movement of young, especially in the canids.

Sections were selected randomly for study; within each section one quarter-section study area was selected at the site which had the best potential for identifying furbearer tracks. Some randomly selected sections had to be relocated to improve field logistics due to remoteness and inaccessibility of some of the original selections or proximity to human habitations. All study areas were surveyed no sooner than 48 hours after a rain. The search pattern consisted of visiting as many locations on each study area as possible on foot within 30 minutes that had potential to reveal furbearer tracks.

Data collected for each quarter-section visited consisted of relative abundance of tracks identified by species (none, scarce, common, abundant), predominant cover type (pasture, hayland, cropland, marsh, idle), relative amount of available track sites (many, moderate, few, almost none), relative soil condition for holding tracks (excellent, good, fair, poor), and the track accumulation period (1 day, 2-3 days, 4-6 days, 7 or more days). Coyote and red fox tracks were distinguished based on size (Allen, unpubl. data). Swift fox tracks are easily distinguished from other canids, because they average about 10 mm shorter than the smallest red fox tracks (Orloff et al., 1993). Data analysis consisted of the examining the number of study areas with furbearer track occurrence by species.

Quarter-sections were selected and examined as above for furbearer tracks to a sample from the nearest public access roadside to that quarter-section for furbearer tracks. No paved roads were included in this testing. Search pattern consisted in examining each sample type for 30 minutes for furbearer tracks. Tracks were identified to species when possible. Differences in numbers of quarter-sections with furbearer tracks were compared to roadsides with furbearer tracks by species with Chi-square.

Population changes are being monitored by spring surveys and computer population modeling. The spread and occurrence of sarcoptic mange is being monitored with data collected from USDA-ADC personnel.

RESULTS

Densities of furbearer species were not determined in this study. Relative occurrence of furbearer species identified on the 44 study areas in 1999 (Table 1) consisted of coyotes (Canis latrans-14x areas), red fox (Vulpes vulpes-20 areas), badger (Taxidea taxus) -1 area, raccoon (Procyon lotor-8 areas) and skunk (Mephitis mephitis-1 area) . No swift fox tracks were identified on any of the 44 study areas. No visual observation of any furbearer was made on any study area. Twenty-six of the 44 study areas contained tracks of at least 1 furbearer species.

Since 1997 no differences have been found in furbearer occurrence on 15 quarter-sections compared to 18 corresponding roadsides for red fox ($X2=0.689$, $df=1$, $P=0.407$) for coyotes

(X2=2.20, df=1, P=0.138) for raccoons (X2=0.061, df-1, P=0.805), or for skunks (X2=0.005, df=1, P=0.943).

Other relative occurrence data for canids are also available in North Dakota. Since 1970 we have obtained 4 confirmed observations of swift fox in North Dakota. During that same time period there have been 701,751 red fox and 213,609 coyotes sold to North Dakota furbuyers.

Red foxes and coyotes in north-central and eastern North Dakota have been strongly impacted by sarcoptic mange. Population size of coyotes are about ½ and red foxes about ⅓ of what they were in 1992.

DISCUSSION

Interspecific competition has been well documented between wolves (Canis lupus) and coyotes (Carbyn 1982) and between coyotes and red foxes (Sargeant et al., 1987) in the northern plains. Interspecific competition from other canids (especially coyotes) may be a significant limiting factor in currently existing swift fox populations in Kansas (L. Fox, 1994 Midwest Furbearer Workshop), and in efforts at reintroduction of swift fox in Saskatchewan (L. Carbyn, 1994 Midwest Furbearer Workshop). Ralls and White (1995) noted that although coyote predation on kit fox in California can be severe, they found indications that red fox predation on kit fox may be catastrophic to the population. Data collected in this study indicate that many quarter-section study areas selected in North Dakota probably have red fox or coyotes or both species present. Track surveys should represent a minimum distribution, because some quarter-sections with no canid tracks observed likely had canids present. Conditions for observing tracks in North Dakota are often far from perfect; however, a few good sites in most quarter sections are all that is often needed to identify one or more species of furbearer present. Considering the hypothesis the observations of Ralls and White (1995) suggest and the density and distribution of red fox and coyotes in North Dakota, the potential for viable swift fox populations may be quite remote. This hypothesis certainly warrants further investigation.

Historically, interspecific competition may not have been as severe on swift fox prior to settlement in the region. At that time wolves were the dominant canid, and coyotes were probably very rare (Johnson and Sargeant 1977). With removal of wolves during and after settlement the canid composition changed and coyotes became more abundant, and conditions for swift fox survival may have deteriorated dramatically. If this hypothesis is correct, the probability for existence of viable natural or reintroduced swift fox populations in this area is extremely limited without major alterations to the present canid community. Alteration of the current canid community to include wolves is not a viable management option in an agricultural environment due to conflicts with livestock. Alteration of the canid community to physically remove the coyotes or red fox is not a viable management option due to prohibitive costs of neutralizing canid dispersal into the control area (Allen, unpubl. data).

Numbers of red fox and coyotes sold to North Dakota furbuyers is the minimum number of these species taken, annually. Not all animals are sold after they are taken, and not all pelts sold are sold to North Dakota furbuyers. Given the magnitude of differences of red fox and coyotes taken as compared to confirmed swift fox observations, we again question if swift fox have very much potential for survival in North Dakota considering the number and distribution of these other canids at present.

The present study also illustrates the paucity of data that is obtained from diurnal observations of live furbearers. Few are seen because of the secretive behavior of these species; however, most randomly selected quarter-section study areas with favorable conditions for locating tracks had furbearer tracks present indicating occurrence of one or more species. In the case of swift fox; however, a visual observation would be required in addition to a track observation to confirm their occurrence, and to eliminate any possible error caused by misidentification of a red fox or coyote pup track. This experimental investigation indicates that various species of furbearers occur on almost all quarter-section study areas, and occurrence of coyotes or red fox or both species is likely on may areas. Other species such as swift fox may be present, but they appear to exist at extremely low levels.

At this point it looks feasible to search public thoroughfare roadsides for tracks of furbearer species and ascertain reliable data on species composition and distribution similar to what would be found on quarter-sections or some other parcel of real estate. This would allow states with problems of access to distribution along public thoroughfares without receiving unnecessary abuse from local private landowners. However, more data needs to be gathered from North Dakota and probably several other locations to reliably determine the potential for this method.

Reintroduction is periodically discussed as an option to expanding distribution into once occupied ranges to augment natural dispersal. Earlier data (Sargeant et al., 1975) shows that red fox have the capacity to change territory size commensurate with densities. Thus, with the lower red fox densities currently present in North Dakota, formerly occupied ranges are still likely completely occupied. Similar, but somewhat more circumstantial, data also exists for coyotes (Andelt 1985). Given this and the current sarcoptic mange epizootic it make little sense to reintroduce swift foxes into areas where 2 major potential mortality agents are present. Subjective cost:benefit analysis indicates the potential for success is virtually non-existent, and the money will be gone.

We identify several research needs for swift fox. We hypothesize that most survey procedures for swift fox that require a behavioral response on the part of the animal to detect this presence in an area will be shown to underestimate distributions compared to control data. This occurs because of shyness behavior in canids especially to foreign objects, lures and placed baits. The potential bias is this: if a lure (e.g. some type of bait, etc.) or object (e.g. live trap or track plate, etc.) is placed in the field and the observer does not detect the animals presence from it, does that mean the animal is not present? The answer is obviously no. In effect, then, the

investigator has actually measured the response rate of the animal to the lure or object, and not necessarily the presence of the animal in the area. In addition, sample sizes are restricted, because each sample site requires 2 or more visits by the investigator to collect data effectively multiplying the man-days needed to collect data by the number of visits.

We encounter some problems with track surveys as well, because we do not always detect tracks of a species even though that species is present, and there is potential for error in correctly identifying tracks to species if inexperienced observers are used. The advantage of track surveys is that nothing special is done that requires a behavioral response on the part of the animal to detect his presence; thus, the potential for behavioral bias in the data on the part of the animal is absent. In addition, sample sizes are maximized, because the investigator only needs to visit a sample site once to obtain the desired data. We suspect that all surveys will show swift fox distributions smaller than the true distribution. However, because behavioral bias is lacking, we suspect track surveys will consistently show larger swift fox distributions with the least bias in the data.

We suggest that determining a standardized survey method that eliminates behavioral bias that can be used by all states to determine maximum distribution of swift fox should receive high priority by the SFCT. This is needed in order to make reliable comparisons of maximum distribution, and to interpret differences in distributions over broad physiographic regions or jurisdictions.

We also suggest that geneticists need to demonstrate definitively if swift fox and kit fox are separate species or merely variations of the same species living in different areas. If the 2 species are separate the case for additional research is very strong. If, however, they are the same species the data base for management increases dramatically with inclusion of all the kit fox data, and the case for endangered species classification in any form becomes very weak with inclusion of several other widely spaced life zones in the species distribution.

The most pressing research need for North Dakota is identifying the role of canid interspecific competition on swift fox. If this behavior is as strong as expected for canids in general and red fox in particular, the potential for a future population of swift fox in North Dakota is remote at best. Other data we will need to have determined from areas that have viable populations are detailed information on reproductive performance (litter sizes) by female age class, population age structure at some point during the year, and annual survival rates by age class group and sex.

Table 1. Number and percent occurrence of furbearer tracks by species and county on randomly selected study sites in southwestern North Dakota - 1999

Species	County and number (%) of quarter-sections with tracks found			
	Bowman (n=20)	Slope (n=18)	Golden Valley (n=2)	Total (n=40)
Red Fox	5 (25.0)	1 (5.6)	2 (100.0)	8 (20.0)
Coyotes	8 (40.0)	7 (38.9)	0	15 (37.5)
Striped Skunk	1 (5.0)	0	1 (50.0)	2 (5.0)
Badger	2 (10.0)	0	0	2 (5.0)
Raccoon	3 (15.0)	5 (27.8)	1 (50.0)	9 (22.5)

LITERATURE CITED

Allen, S. H. 1983. Comparison of red fox litter sizes determined from counts of embryos and placental scars. J. Wildl. Manage. 47: 860-863.

Allen, S. H., J. O. Hastings, and S.C. Kohn 1987. Composition and stability of coyote families and territories in North Dakota. Prairie Nat. 19: 107-114.

Andelt, W. F. 1985. Behavioral ecology of coyotes in south Texas. Wildl. Monogr. 94, 45 pps.

Bailey, V. 1926. A biological survey of North Dakota. USDA, Bur. Biol. Surv. N. Amer. Fauna No. 49, 226 pp.

Brussard, P. F. 1985. Minimum viable populations: how many are too few? Restoration and Manage. Notes 3:21-25.

Carbyn, L. N. 1982. Coyote population fluctuations and spatial distribution in relation to wolf territories in Riding Mountain National Park, Manitoba. Can. Field Nat. 96:176-183.

Johnson, D. H. and A. B. Sargeant. 1977. Impact of red fox predation on the sex ratio of prairie mallards. USFWS Wildl. Res. Rept. 6, 56 pp.

Orloff, S. G., A. W. Flannery, and K. C. Belt. 1993. Identification of San Joaquin kit fox (Vulpes macrotis mutica) tracks on aluminum tracking plates. Calif. Fish and Game. 79:45-53.

Ralls, K. and P. J. White. 1995. Predation on San Joaquin kit foxes by larger canids. J. Mammal. 76:723-729.

Sargeant, A. B., S. H. Allen, and J. O. Hastings. 1987. Spatial relations between sympatric coyotes and red foxes in North Dakota. J. Wildl. Manage. 51: 285-293.

Sargeant, A. B., R. J. Greenwood, M. A. Sovada, and T. L. Shaffer. 1993. Distribution and abundance of predators that affect duck production-prairie pothole region. U. S. Dept. Interior, Fish and Wildl. Serv. Res. Public. 194., 96 pp.

Sargeant, A.B., W. K. Pfeifer, ans S. H. Allen, 1975. A spring aerial census of red fox in North Dakota. J. Wildl. Mange. 39:30-38.

Thwaite, R. G. 1953. Original journals of the Lewis and Clark expedition. Arno Press (Houghton Mifflin Co.).